CONSUMER SATISFACTION, LANGUAGE USE, AND MARKETING TO WOMEN IN THE NEW YORK STATE BEER INDUSTRY
AND
ANTHOCYANIN PROFILES OF COMMERCIALLY IMPORTANT HYBRID GRAPE CULTIVARS

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ABSTRACT

The New York State craft brewing industry is growing rapidly, becoming an increasingly crowded field for consumers to navigate and for producers to stand out. Several arms of research were conducted to help breweries understand their consumers better. Surveys of patrons of New York State breweries were used to investigate the connections between consumer experiences in tasting rooms, customer satisfaction, and the purchase decisions they make. Comfortable interiors and friendly, knowledgeable servers were found to increase the overall sense of customer satisfaction which, in turn, was associated with increased sales.

Several subsequent focus groups were held to explore consumer experiences and language use. The first studied the connection between the expertise in beer that a consumer had and the language that the consumer used to describe beer. Increasing expertise did lead to changes in language use, with increasing industry-specific language. Additionally, it was found that there was a concept of "too-sweet" associated with traditionally sweet foods that became less central to consumers purchase decisions as they became more expert. Another focus group, one composed entirely of women, examined what qualities made breweries and beer labels, with labels used as a proxy for marketing in general, appealing to women. Female focus group participants indicated that they wanted comfortable spaces, quality beer, and welcoming service. It was also found that labels that focused on local and natural imagery were ranked higher than those with geometric motifs or sexual overtones. These studies present actionable data for New York State breweries to help them better serve and increase their appeal to consumers in a marketplace that is becoming increasingly crowded.

Another New York State product, red hybrid grapes used for winemaking, are known for producing wine that has commercially undesirable color development when compared to wine made from *Vitis vinifera* varieties. Anthocyanins are the family of molecules that provide the basis

of color in wine. The anthocyanin content of six commercially important interspecific hybrid cultivars, and two *V. vinifera,* were profiled to understand the drivers of color development in these cultivars. *V. vinifera* cultivars were found to have much lower percentage of mono-glucosides than hybrid cultivars. Hybrid cultivars in general had a greater diversity of species of anthocyanins identified within each sample.

BIOGRAPHICAL SKETCH

Sara Wagner is currently a Master's student at Cornell University. She has previously studied classics at St. John's College where she received a Bachelor of Arts degree in Liberal Arts, and enology and viticulture at Finger Lakes Community College. Sara has worked in the wine industry in a variety of positions. At Sheldrake Point Vineyards she worked as a cellar hand, at Lamoreaux Landing Cellars she managed the tasting room, and at Houghton Winery she worked in the laboratory. Additionally, Sara worked as a field researcher in grapes and apples for ACDS.

For my father, David, who taught his daughters ask questions, dig deeper, and reach higher.

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INTRODUCTION

Beer Consumer Studies

Craft breweries are an important part of the New York State economy that support broad range of industries, representing more than 3.5 billion dollars of economic impact in the state (Insel 2015). The success of New York State breweries in this crowded marketplace, which offers an array of choices for on- and off-premise alcohol consumption, will rely on understanding what customers want and how they respond to brewery visits and marketing. In order to serve New York State breweries with actionable information, a survey was formulated to investigate the relationship between specific brewery attributes and spending decisions. This survey, based on one developed for wineries (Shapiro and Gomez 2014), takes as a central argument that customer satisfaction is a primary driver of sales and is itself driven by factors that can be measured by consumers when they interact with a retailer (Gomez, McLaughlin, and Wittink 2004a). We will show that this argument holds up for breweries as well, producing actionable results for tasting room managers.

Breweries produce marketing materials that should appeal to their intended audience. Research has shown that consumers can be categorized into different echelons based on their level of sensory and product expertise (LaTour and LaTour 2010), and that different consumers will use different language to describe the same product (Giacalone et al. 2016). A series of focus groups utilizing the spectrum of expertise concept to separate beer-consumers into novice, intermediate, and expert were convened to investigate how these different consumers used and understood beer descriptors. New York State breweries will be able to utilize information ascertained from these focus groups to more clearly communicate with their target consumers.

While researching and recruiting participants for the first project researchers noted a lack of information on how gender affected the brewery experience and beer marketing. Indeed, the

beer industry has long been seen as an overtly male space (de Visser and McDonnell 2012), beer marketing can be downright sexist (Polonsky et al. 2001), and figures from the researchers' own survey of New York State breweries suggest that the majority of consumers were male (Wagner 2017). However, so much economic power is held by women (Rowley 1999; Nielsen 2013) that it would be foolish for New York State breweries to overlook this demographic as place of potential growth. A series of women-only focus groups were organized to study women's experiences of breweries and beer marketing. Two major themes were examined, the preferred qualities and experiences women wanted when they went to a brewery or other drinking establishment in person, and their opinions on a variety of beer labels as proxies for general marketing techniques. New York State breweries can use the information gathered in these sessions to develop marketing strategies that appeal directly to women. They can also manage their customers' experience so that women feel more welcome and appreciated as customers.

Anthocyanin Profiles

New York State wineries also have to compete for consumer's dollars. Wine color affects the commercial appeal of a wine (Berger 2006). Anthocyanins, common tri-cyclic phenolic compounds in the flavonoid family (Ozeki et al. 2011), are responsible for the red color of wine. Anthocyanin profiles can be distinct enough to be used to identify cultivars (Geana, Iordache, and Ionete 2011). This is valuable information, not just for fraudulent claims identification, but for identifying the aging potential for wines made from particular grape cultivars. Di-glucoside anthocyanins will not change color, through processes of co-pigmentation and polymerization, over time in the same way mono-glucoside anthocyanins will, but rather are more prone to bleaching (Waterhouse, Sacks, and Jeffrey 2016). Therefore, cultivars with higher proportions of monoglucosides than diglucosides tend to produce more commercially acceptable wine color. Some cultivars also have high ratios of specific anthocyanins, like delphinidin, that may produce

particularly blue hues (He et al. 2012). The ratios of particular anthocyanins may also affect the final outcome of a wine's color (Burtch, Mansfield, and Manns 2017).

In order to more fully understand the relationship of anthocyanins in commercially important interspecific hybrids, especially in several newer cultivars, samples of grapes were taken across the Finger Lakes region and their anthocyanin portion separated. The samples were analyzed via HPLC, and the peaks in resulting chromatographs were identified, using previously validated data, and mean anthocyanin profiles were created. Wineries can use this information when they choose grapes to vinify and blend in order to have greater control over the color of their wine. Grape breeders can also use this information when deciding which cultivars have the qualities that are desirable to propagate into a new cultivar. This information will allow a grape-breeders to see beyond surface color into the possible aging possibility of a wine grape.

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CHAPTER 1

Consumer Experiences and Purchasing Decisions in New York State Brewery Tasting Rooms

Introduction

Customer satisfaction (CS) is essential to the success of small regional breweries in a marketplace crowded with an array of choices for on- and off-premise alcohol consumption. For small breweries selling a majority of their product on-site, CS is greatly influenced by the tasting room experience. Breweries and brewpubs depend on close customer interactions with their product, facility, and employees to create a favorable experience, so owners and tasting room managers strive to create experiences that maximize customer engagement, spending, and return visits.

Research examining the influence of CS in other retail industries, most notably a 2010 study of the New York State wine industry (Gomez et al 2010), has shown the importance of CS in determining whether customers make a purchase, their purchase volume, and the dollar amount spent. There is no similar, cotemporaneous study related to breweries in New York State or nationally. Although certain assumptions can be made about the similarities between the wine and the beer industry as they relate to customer interaction and tourism, it is unknown how much the attributes contributing to CS and consumer behavior vary. Tasting rooms managers currently have no scientifically-backed rubric of CS determinants, and must rely on their own experience and hearsay to help them boost and maintain CS. An industry-specific understanding of CS factors

will help regional brewers make appropriate investment in their products, marketing, training, and facilities.

Breweries in New York State rely on several business strategies to get product to market; while a number of large breweries distribute nationally, many small, owner-operated breweries distribute locally or not at all. These small breweries do not own or have access to a canning line, and only sell their product out of their tasting room in growlers, relying on their share of the 3.66 million annual visits made to New York State breweries (Stonebridge 2013). Small- to medium-sized breweries' profits hinge on CS, as a high percentage of their customers, as many as 100%, will pass through their tasting room. Greater CS will increase the likelihood that these customers will spend more on their visit, recommend the brewery to their friends, and make subsequent visits. This study looks at the qualities of a tasting room experience and determines how they affect overall CS and ultimately, how CS affects a customer's purchasing decisions.

Why Customer Satisfaction?

Satisfied customers are the core of every business. Research has shown that companies with high CS provide higher returns to investors (Hart 2007). Breweries are in an especially competitive market, where unhappy customers have little reason to stay loyal to a brand that they are unsatisfied with. In New York State there were 207 operating breweries in 2013 (Insel 2015) which had grown to 400 by 2017 (Office of the Governor 2017); this adds a wide array of local options to a market already crowded with national and international brands. In such a packed marketplace it takes more effort from breweries to stand out and be remembered by consumers, but those that do can be rewarded. Thach and Olsen showed that high marks in brand differentiation and customer satisfaction were strongly correlated with customer loyalty (Thach and Olsen 2006).

Because it is easier and less expensive for a business to keep existing customers than to recruit new ones, it has become regular practice to investigate customer defection in order to gauge factors important to overall customer satisfaction, and to more actively pursue complaining customers in an attempt to retain them and maximize profits (Hart 2007). The average packaged goods company may lose ten percent of its customers annually (Kotler and Keller 2006), but even a small reduction in those losses can result in dramatic gains in profitability if customers who consider leaving can be induced to remain (Fornell and Wernerfelt 1987). A recent study showed that customers average their most recent experience, good or bad, with the entirety of their experiences with a company, and that this average is used to make decisions (Martins Gonçalves and Sampaio 2012). The longer a customer has been with a company, the more likely they are to remain, rather than move to a competitor, following a single poor experience. This suggest that breweries that have longstanding good reputations can indeed "rest on their laurels," but that eventually customers will reevaluate and downgrade their assessment of the brand if they experience several negative interactions.

Retaining a customer over time isn't the only reason to track CS, as a loyal customer will provide a number of additional financial benefits. Brown and Gremler (1999) describe a kind of virtuous cycle, where satisfaction inspires loyalty, which in turn inspires continued satisfaction. Among other positive word-of-mouth communications, loyal customers are more likely to encourage patronage of a business through recommendations. Bolton showed that CS was as important as price in influencing a customer's decision on retailer choice (Bolton 1998). In a crowded, sometimes price-insensitive marketplace, it's impossible to encourage customer loyalty without delivering customer satisfaction.

A good way to increase brewery sales is to focus not on customers whose current level of CS is earning the brewery valuable business, but those who can be persuaded to improve their

opinion. The links between measurable attributes and the satisfaction-profit chain is asymmetrical and non-linear (Anderson and Mittal 2000). Non-linearity means that a customer who moves from "somewhat unsatisfied" to "neither satisfied or dissatisfied," in our study a move from a score of 2 to a score of 3, may be less valuable and traverse less conceptual distance than one who goes from "somewhat satisfied" to "very satisfied," equal to moving from a 4 to a 5 in our study. Even if these phrases separated by the same physical or numerical distances according to the scale used for measurement, they may not reflect equal amounts or changes in CS. For example, a customer who is "somewhat unsatisfied" because of rude staff may leave the brewery without purchasing anything and never plan to return, while if their experience was improved slightly by improving service by staff to "somewhat satisfied," the customer may make a token purchase. If that same customer's experience was enhanced to the point that they rated themselves "very satisfied," they may make a large purchase and be much more likely to return and bring guests. The rate of change in purchase decisions is heavily weighted to the more satisfied end of the spectrum. On the other hand, customers may treat the cleanliness of a brewery as binary, heavily penalizing breweries perceived as dirty but giving no benefit to clean breweries. These different hedonic values may, depending on the scale used, seem equally spaced, but indicate greater and lesser changes in purchase decisions.

Literature Review: Craft Beverages and Customer Satisfaction

Research shows that higher CS is associated with higher revenues and stronger brand loyalty in several markets, including grocery stores, department stores, and cell phones (Gomez, McLaughlin, and Wittink 2004; Westbrook 1981; Vásquez-Parraga, Zamora-González, and Torres-Moraga 2008). CS is more closely tied to profitability than the more traditional metric of productivity, especially in businesses containing a service component (Anderson, et al 1997). Consequently, it is no surprise that businesses achieving higher CS succeed in both reducing costs

and expanding overall revenue, leading to long-term financial health. A focus on CS should comprise a major component of a business's marketing strategy for continued success in the marketplace.

In 2013 an estimated 15% of beer produced in New York State was sold direct-to-consumers through brewery tasting rooms or brewpubs; this amounted to approximately 129 thousand barrels of beer worth $116 million USD (Insel 2015). Though all direct-to-consumer purchases are impacted by CS, research on the experience of breweries customers is scarce and research tying CS to purchase decisions in breweries nonexistent. Despite this dearth of brewery-specific work, previous work in the broader marketplace has shown that improved CS increases purchase intention and brand loyalty, and that satisfied customers are more likely to advertise the brand to friends by word of mouth (Anderson et al. 1997, Brown and Gremler 1999). The tasting room is where a brewery has the most access to its customers and can influence their purchase decisions.

Customers are not only influenced by product style when making purchasing decisions, but also the perception of quality. Previous studies have found that consumers are efficient at integrating outside information about the quality of a generic product into their purchasing behavior, which can prompt companies to invest in the real quality of their product (Fishman and Simhon 2000). If outside information is scarce or poorly integrated into the economy, then poor quality products can compete on the same level as high-quality ones. Product quality, existing as a publicly-created concept synthesized by professional beer writers, beer review apps, websites, and word of mouth recommendations, is important for breweries to manage. For breweries, this information is either free or relatively inexpensive and easy to obtain with internet access, therefore few low-quality beers will be able to "piggyback" on the well-made before they are weeded out. In a study of general consumer habits, quality was found to be integral to a customer's perception

of value, another important factor in CS (Cronin et al 2000). Positive relationships with salespeople created on the sales floor can "spill over," creating a sense of loyalty to the business itself in upscale retail locations (Reynolds and Arnold 2000). Subsequently, staff in the beverage industry that are able to understand and exceed customer expectations will positively influence their customer's CS, which can have increasing effect over a long business-customer relationship (Po-Hsuan Wu et al 2014). Managing and increasing CS is an important method for a brewery to increase their financial health.

Conceptual Framework and Data Collection

Gomez established a conceptual framework for connecting CS to purchase decisions (Gomez et al. 2004) positing that customer satisfaction is the combined impact of many measurable, discrete attributes of the customer's experience, which can be grouped into a broader set of meta-factors that encompass multiple related attributes of the customer experience. Some meta-groupings of related but distinct attributes were found to be a better predictor of Overall CS. For example, satisfaction with a tasting room's music/ambient noise and bathroom cleanliness, while conceptually distinct, are generally ranked similarly by a single consumer, making them related component parts of the broader "Brewery Interior Experience" category. Using this model, consumers who score higher Overall CS generally spend more money, purchase more fluid ounces, and indicate a higher likelihood of making a purchase.

Data collection was carried out via paper questionnaires distributed at 21 participating breweries across New York State between Feb 1 – Feb 28, 2017. Breweries were recruited through the New York State Brewer's Association, an industry organization. All interested, volunteer breweries were accepted into the study. In total, 802 questionnaires were completed and returned, an average of 37 questionnaires from each brewery. In the month previous to the survey period,

paper questionnaires were delivered in person to all participating breweries, and researchers met with tasting room managers to review data collection procedures. In lieu of hand delivery, questionnaires were mailed to two distant breweries and instructions were discussed in a phone meeting. Written instructions were mailed or left with staff as an additional resource.

The survey questionnaire was based on the conceptual model outlined above, eliciting information on overall satisfaction; satisfaction with particular, actionable aspects of the tasting room visit experience; and purchasing behavior. Twenty-three aspects of the tasting room experience were grouped into five broad categories (category titles themselves were not scored): "Brewery Interior Experience," "Your Server," "Your Beer Experience," "Retail Sales," and "Brewery Location." Individual attributes included such items as the ambiance of the interior space, the friendliness of the server, the cleanliness of the restrooms, the variety of beers available to taste, etc. (Table 1.). This questionnaire was a modified version of a previous instrument used in the study of consumer behavior in wineries (Shapiro and Gomez 2014), and included an introduction outlining the voluntary nature of the survey, the anonymity of the participant, and the basic intent of the research. No personally identifiable information on survey participants was recorded.

A five-bin, hedonic scale was used to gather participant's responses to each aspect and to Overall CS titled, "Overall Brewery Experience." An additional, null bin labeled "Not Applicable," was provided as an option for all questions. An "Overall Restaurant Experience" question was included to prevent opinion overflow in breweries offering food service experiences, though this information was not analyzed.

The questionnaire also asked for demographic information: age, gender, zip code of residence, and highest education level achieved. Participants were asked to indicate what factors in the list provided prompted them to stop at the brewery that day. Finally, the questionnaire

inquired about a participant's purchase behavior that day, if and what they purchased, how much they spent, if they intended to purchase that brand again, how often they purchased any beer, etc. After the survey period closed, the data was entered into a database and analyzed to determine fit to hypothesized model, what factors drove CS and purchase behavior, and how great the effect of each factor was.

Methods

Data was analyzed using a principal component factor analysis to aggregate attributes driving CS. A multiple regression analysis was used to assess the influence each CS factor on a customer's reported Overall CS. Last, a multiple regression and discrete choice models were applied to assess the effect of levels of Overall CS on consumer spending decisions.

The original survey inquired about 23 different tasting room attributes, too many for meaningful statistical interpretation. Following Gomez et al (2010), principal component factor analysis and a Varimax factor rotation were used to aggregate the 23 tasting room attribute measures to a smaller set of CS factors. Each of the CS factors would represent, as Gomez explains, "a linear combination of a subset of the [surveyed] attributes". All factors with eigenvalues exceeding one were considered in ascending order, until all surveyed attributes were accounted for (Table 2.) An average of attributes loading highly on a CS factor (0.4 or more) were used as a replacement for factor scores (Table 3.) The factor score equivalent for each CS factor is an unweighted average of its attributes' factor loadings. Following Gomez et al (2010) the factor analysis was used to create a vector of CS factors, ($F_i, F_2 \ldots F_M$), where F_i represented the score of attribute factor i and M is the number of CS factors. This method reduces the number of factors affecting customer satisfaction while retaining the most pertinent qualities and greatest variations in the data.

The effect of aggregated and averaged tasting room factors on Overall CS was tested with multiple regression analysis. After establishing the factor scores, a regression equation was created in which Overall CS scores are a function of the factor scores:

(1) $Overall\ CS = \alpha_0 + \alpha_1 F_1 + \alpha_2 F_2 + \alpha_3 F_3 + \alpha_4 F_4 + \ldots + \alpha_M F_M + \varepsilon_1$.

Ultimately, the impact of Overall CS on consumer spending decisions was assessed, while controlling for customer demographics including age, gender and education level. The following sales performance measures were used: purchase intent or buy/not buy *(Buy* equals 1 one if the customers bought beer for consumption on or off-premise; *not buy* equals zero), the number of oz. purchased in the visit *(Oz.,* number specified*),* and the amount of dollars spent in the visit (*Dollars,* number specified). Following Gomez et al (2010), the equations examining the link between overall CS and purchase decision were:

(2) $Buy = \beta_0 + \beta_1 Overall\ CS + \beta_1 Gender + \beta_3 Age + \beta_4 Education + \varepsilon_2$

(3) $Oz. = \beta_0 + \beta_1 Overall\ CS + \beta_1 Gender + \beta_3 Age + \beta_4 Education + \varepsilon_3$

(4) $Dollars = \beta_0 + \beta_1 Overall\ CS + \beta_1 Gender + \beta_3 Age + \beta_4 Education + \varepsilon_4$

where *Gender, Age,* and *Education* are the gender, age and education level of the respondent (Table 4). Equations (3) and (4) were properly estimated using Least Ordinary Squares because the dependent variables were continuous. However, a logit model was required for equation (2) as the dependent variable was dichotomous.

Factor Analysis Results and Descriptive Statistics

The factor analysis of the survey resulted in the aggregation of the tasting room attributes under five generalized headings, and one attribute (Presentation of beer flight paddle, in "Beer Tasting") was dropped because it correlated poorly with all CS factors (Table 4.) Each CS factor was named to indicate its component attributes. 'Brewery Interior Experience' is associated with

the tasting room's lighting, soundscape, cleanliness of bathroom, overall ambiance, and the helpfulness of staff. 'Server' is associated with staff member interactions while being served beer, and includes impressions of the server's knowledgeability, friendliness, and personal neatness. Next, 'Beer Tasting' included attributes that relate to customers who order or taste beer in a flight (a common method of serving several small portions of different beers at once), those who taste at a more conventional setting like a tasting bar, and those who "try a beer" by ordering a pint. This CS factor included the range of choices available and presentation method for flights, the wait time for a place at the tasting bar, the fee associated with tasting, the number of samples offered, and the overall quality of the beer tasted. 'Retail' included attributes associated with shopping and making purchases at the brewery including the availability, price, and presentation of beers for sale as well as the availability of non-beer items (bottle openers, t-shirts, souvenirs, etc.). The last CS factor, 'Location' had only two attributes, the helpfulness of directional signs to the brewery and the appeal of the building exterior.

The descriptive statistics of the tasting room CS factors, sales information, and respondent demographics employed for estimation in equations (1)-(4) are displayed in Table 4. The CS factor scores are the average of the scores of each attribute that have been aggregated to form that CS factor, and are unweighted.

Participants in the survey were asked to provide basic demographic information including gender, age, education level and home zip code. Demographic questions were all free response except education level, which offered four options classified as 1 (high school or less), 2 (some college), 3 (college degree), or 4 (graduate training/degree). Gender responses were coded as (0) for female, (1) for male, and (2) for non-binary or other responses. Age was coded as the closest whole number to the written response. Zip codes reflecting residence within New York state were coded (1) and those outside the state (0). The gender breakdown was 59% male and 41% female,

with two participants reporting a non-binary or other gender. The average age in our sample was 41.2, and approximately 10% of customers came from out-of-state. The average education level was 3.04, indicating college-level education.

The CS factor 'Beer Tasting' was the highest scoring factor at 4.91 (out of 5). The next three CS factors 'Brewery Interior Experience,' 'Server,' and 'Retail' made up a broad middle of scores in the high 4's (4.75, 4.71 and 4.50, respectively). 'Location' was the lowest scoring CS factor, coming in at 4.19. Overall, these scores are at the high end of the range, indicating customer experiences that are satisfactory. The average Overall CS score was also very high (4.85) suggesting that visitors to the participating breweries were highly satisfied with their reported experience. Among survey participants, 73 percent planned to or did purchase beer during their visit; on average these participants purchased 80.06 oz and spent $31.07 on beer (excluding other spending on food).

Results and Discussion

The results of the parameter estimate from equation (1) are presented in Table 5 to show how aggregated CS factors are related to Overall CS. The pseudo R-squared for this regression is 0.348, indicating that nearly 35% percent of the variation in Overall CS can be explained using the five CS factors developed in this study. This result is generally in line with other studies in food and beverage service (Shapiro and Gomez 2014; Gupta, McLaughlin, and Gomez 2007), though breweries seem to get a bigger CS boost from similar CS factors perhaps because their offerings are simpler and more streamlined than restaurants.

These results suggested that the CS factors 'Brewery Interior Experience' and 'Server' make the greatest difference to a customer's overall satisfaction, accounting for 10% and 11% respectively. Each 1-point increase in satisfaction in the CS factors 'Brewery Interior Experience'

or ‘Service’ lead on average to a 0.1-point or 0.11-point increase in the overall CS score *(p* <0.01). This suggests that the inverse is also true; that if scores in ‘Brewery Interior Experience’ and ‘Server’ dropped by a point, then overall scores would drop as well. The CS factor ‘Beer Tasting’ was somewhat important, having a measured impact of about 4% of the overall CS, though the result is not significant *(p* < 0.10). The other two factors, ‘Retail’ and ‘Location’ had small measured impact on overall CS, at 0.7% and 1.3% respectively.

Higher reported overall CS was also associated with consumer decisions that lead to positive sales results: greater likelihood to purchase, more fluid ounces purchased, or more dollars spent (Table 6). This suggests that if a customer experienced 1-point increase in CS they were 11% more likely to make a purchase, spend $4.61 more, and end up buying 22 oz more beer. The regression analysis of the purchase intent and fluid ounces purchases are significant (*p* < 0.01*),* as well as that of dollars spent *(p* < 0.05). When queried about intent to repurchase, every respondent answered yes; therefore, repurchase intent is not associated with any one factor, attribute, or demographic.

Generally these results were in agreement with previous research on craft beverage tasting rooms, which showed that the atmosphere of the tasting room and the interactions of the tasting room staff were important to customer’s overall reported CS (Shapiro and Gomez 2014; Kraftchick et al. 2014). Interestingly, the CS factors ‘Beer Tasting’ and ‘Retail,’ which contain, respectively, the attributes of the quality of the beer made and sold by the brewery and the cost of the beer, are not as important as the more experiential and relational attributes involved in ‘Brewery Interior Experience’ and ‘Service.’ This suggests that consumers are not particularly price sensitive, and create their conception of ‘value’ of the product they are purchasing from the context in which it was served, as well as from intrinsic qualities and price (Carlsen and Boksberger 2015).

Table 7 utilizes the parameter estimates from Table 5 and the mean impacts of customer satisfaction on sales data in Table 6 to replicate the scenario of converting a visitor from "Satisfied" (score=4) to "Highly Satisfied" (score=5). When overall satisfaction rating moves from 'Satisfied' to 'Highly Satisfied,' a customer's probability of purchase increased from 73% to 84% (an increase of 11%), they were likely to purchase 102.06 ounces of beer instead of 80.06 (an increase of 22 ounces), and spend $35.68 instead of $31.07 (an increase of $4.61). Breweries should note that this projection works both directions, and customers whose satisfaction scores decrease are just as likely to purchase less frequently and make purchases smaller in volume and price.

Demographics did not have a significant effect on consumer purchase decisions, with the exception of gender effect on purchase intent. Male customers were 5% more likely to make a purchase than women, a significant (p <0.05) result. This set breweries apart from another craft beverage purveyor, wineries, where age was the most salient factor in determining dollars spent and volume purchased; older customers were more likely to buy more and spend more money when they did (Shapiro and Gomez 2014).

Conclusions

This study shows that identifiable factors, like interior ambiance and staff friendliness and knowledgeability, are significant drivers of overall CS in New York State brewery tasting rooms. This case study also indicates that the Overall CS influenced several consumer behavior measures, including intention to purchase, number of dollars spent, and total fluid ounces of beer purchased at a particular visit.

These findings are useful to brewery tasting room managers, especially those that do little to no distribution and rely on tasting room sales to make their bottom line. Breweries that rely on distribution networks can utilize these findings to increase customer satisfaction and brand loyalty in the space where they exert the most control over interactions – the tasting room. A quantitative

model linking attributes and outcomes is the most accurate way to understand what factors influence customers. A program that tightly controlled CS might include eliciting customer feedback, active complaint management, and ability to meet and exceed new needs and desires as they arise and could be a worthwhile investment for brewery tasting room managers.

This investigation can be extended to address several unexplored areas in the customer satisfaction-performance links in breweries, like the sensitivity of satisfaction factors to offers of specific entertainment or educational options (concerts, festivals, tours). Further, this survey could be repeated at different times throughout the year, thus capturing a fuller picture of the tourism economy and producing a managerial tool responsive to the seasonal nature of the industry. Finally, future empirical investigations should survey participants about frequency of patronizing a particular brewery to gain insight about CS effects on customer loyalty and retention.

TABLES

Table 1. Attributes Included in Customer Satisfaction Factors for Breweries

Factor	**Attributes in Factor**
Brewery Interior Experience	• Ambience of the tasting room • Lighting in the tasting room • Sounds in the tasting room • Helpfulness of staff • Cleanliness of the bathrooms
Server	• Server's friendliness • Server's knowledge of product • Personal neatness of Server
Beer Tasting	• Tasting fee • Choice of beers/flights • Number and volume of beers poured • Accuracy of beer descriptions • Uniqueness of beer offerings • Quality of beer • Presentation of beer samples
Retail	• Availability of beer for sale • Presentation of beer for sale • Beer prices • Variety of beers offered for sale • Variety of non-beer gift items for sale
Location	• Ease of finding the brewery due to signage • Appeal of brewery exterior

Table 2. Eigenvalues of CS Factors in Brewery Tasting Rooms

Factor	Eigenvalue
Factor1	8.40533
Factor2	1.75198
Factor3	1.38197
Factor4	1.34056
Factor5	1.12706
Factor6	1.07137
Factor7	0.91662
Factor8	0.84554
Factor9	0.66691
Factor10	0.63868
Factor11	0.58592
Factor12	0.54823
Factor13	0.52427
Factor14	0.51265
Factor15	0.43510
Factor16	0.38809
Factor17	0.33642
Factor18	0.31226
Factor19	0.27572
Factor20	0.27009
Factor21	0.25183
Factor22	0.22394
Factor23	0.18947

Table 3. Factor Loadings for CS Factors in Brewery Tasting Rooms

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Interior1	0.4784	-0.1927	0.2198	0.4090	0.3797
Interior2	0.2377	0.1159	0.1189	0.5792	0.3991
Interior3	0.0660	0.3711	0.0400	0.6572	0.2776
Interior4	0.0573	0.1891	0.2201	0.6857	-0.1536
Interior5	0.2036	0.0459	0.1454	0.7161	0.0583
Server1	0.2037	0.3711	0.7550	0.3009	-0.1038
Server2	0.0363	0.2678	0.7501	0.1144	0.1517
Server3	0.1304	0.0496	0.7568	0.0033	0.2348
Beer Flights Only1	0.4232	0.4494	0.1501	0.2490	0.1927
Beer Flights Only2	0.7465	0.2257	0.0751	0.2152	0.0158
Beer Flights Only3	0.7790	0.2793	0.0475	0.1453	0.1358
Beer Flights Only4	0.6828	0.2025	0.2540	0.0208	0.2014
Beer Flights Only5	0.5699	0.3300	0.2019	0.1762	-0.0054
Beer Flights/Pints1	0.4952	0.3809	0.2787	0.0579	0.1986
Beer Flights/Pints2	0.4481	0.4304	0.2755	0.0001	0.0950
Beer Flights/Pints3	0.3677	0.3246	0.3154	0.0662	0.2542
Retail1	0.2805	0.6861	0.1572	0.0736	0.1891
Retail2	0.1194	0.7587	0.2509	0.1640	0.2558
Retail3	0.3133	0.7187	0.0570	0.2068	0.0952
Retail4	0.4562	0.5280	-0.0220	-0.0444	0.2819
Retail5	0.3341	0.5998	0.0374	0.1666	0.1011
Location1	0.0879	0.2991	0.0895	0.1279	0.7667
Location2	0.1376	0.1601	0.0997	0.0347	0.8216

Table 4. Mean for Tasting Room Customer Satisfaction Factors, Sales Information, and Brewery Customer Demographics (N=784)

Variable	Description	Mean
Brewery Interior Experience	Refer to Table 1; Based on ratings from 1 (poor) to 5 (excellent)	4.75 ± 0.33
Server	Refer to Table 1; Based on ratings from 1 (poor) to 5 (excellent)	4.71 ± 0.41
Beer Tasting	Refer to Table 1; Based on ratings from 1 (poor) to 5 (excellent)	4.91 ± 0.25
Retail	Refer to Table 1; Based on ratings from 1 (poor) to 5 (excellent)	4.50 ± 0.54
Location	Refer to Table 1; Based on ratings from 1 (poor) to 5 (excellent)	4.16 ± 0.88
Overall Customer Satisfaction	Based on ratings from 1 (poor) to 5 (excellent)	4.85 ± 0.38
Intention to purchase	0 (no) or 1 (yes)	0.73 ± 0.39
Fluid ounces purchased	Based on industry averages of pints, 12-oz six packs, and 64 oz growlers	80.06 ± 73.56
Amount of dollars spent	Actual or customer estimated amount spent on beer	31.07 ± 28.46
Age	No one under 21 took the survey	41.22 ± 13.34
Gender	0 (female) or 1 (male)	0.59 ± 0.51
Education	1 (high school or less), 2 (some college), 3 (college degree), or 4 (graduate degree/training)	3.04 ± 0.90
Zip Code	In-state (1) Out-of-state (0)	0.91 ± 0.28

Table 5. Regression Analysis of Overall Customer Satisfaction in Brewery Tasting Rooms

Variable (Factor)	**dy/dx**	**P> |z|**	**Standard Error**
Brewery Interior Experience	0.104	0.005	0.037
Server	0.113	0.018	0.048
Beer Tasting	0.05	0.201	0.039
Retail	0.007	0.802	0.03
Location	0.013	0.362	0.014
R-Squared	0.348		
No. Observations	258		

Table 6. Impact of Brewery Customer Satisfaction on Alternative Measures of Sales Performance Measures in Breweries

Variable	**Plans to purchase Mean** ***(S.E.)***	**Dollars spent Mean** ***(S.E.)***	**Fluid Ounces Purchased Mean** ***(S.E.)***
Overall CS	0.105** *(0.039)*	4.61* *(1.964)*	21.56*** *(6.784)*
Male	0.055*** *(0.013)*	3.172 *(1.389)*	7.99 *(4.791)*
Age	-0.064 (0.061)	-0.04 (0.051)	0.238 *(0.177)*
Education Level	-0.061 *(0.067)*	-0.767 *(.768)*	-3.971 *(2.643)*
R-Squared	--	0.021	0.029
Prob > F	0.003	0.015	0.001
No. Observations	632	586	625

*, **, *** denote statistical significance at the *(p* <0.10*), (p* <0.05), and *(p* <0.0.1), respectively. S.E. denotes standard errors.

Table 7. Impact on Purchase Decisions of Converting a Visitor from "Satisfied" (score=4) to "Highly Satisfied" (score=5) on Sales Performance

Performance Measure	**Sample Average**	**Impact**
Probability of purchase	73%	84%
Average fluid ounces purchased	80.06	102.06
Average amount of purchase ($)	$31.07	$35.68

Source: calculated based on parameter estimates in Table 6 and sample averages in Table 5.

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CHAPTER 2

Talking to Beer Drinkers: Do Craft Beer Consumers Understand Beer-Geek Speak?

Background

The New York State craft brewery industry is a vital and growing part of the state-wide economy. New York State craft breweries are currently producing more than a million barrels of beer a year with an annual economic impact of $4 billion (Insel 2015). This growing industry and consumer base will be best served if breweries communicate using descriptive sensory language in consumer facing texts that consumers understand and appreciate. Consumers of craft beer may have a wide range of expertise in beer consumption and sensory description, and studies show that consumers at different expertise levels use different words to describe the same product (Latour and Latour 2010, Giacalone 2016). When a description of a wine conflicts with a consumer's perception of it, they can experience negative emotions like frustration or confusion that may make them less likely to purchase from that producer again (Thomas et al. 2014, Danner et al 2017). Though effect has not been studied in beer, there is reason to believe that the same language gap observed in wine may hamper beer producer-to-consumer interactions.

Experimental Design

In order to determine how consumers with different knowledge levels use language to describe New York State beer, consumers were separated by expertise and invited to three different ninety-minute focus groups. Participants were recruited from the Cornell Sensory Center's standing Alcoholic Beverage Consumer Panel and given additional screening questions to determine beer expertise. Screening included beer trivia questions, questions about sensory training and work experience in the beer industry, and number of years panelists have consumed

beer. Participants were separated into three groups based on their previous experience with beer and beer making, their education in sensory description, and their adherence to trends associated with greater beer experience (Table 1).

Table 1. Expertise and Language Beer Focus Group Demographics

Classification	Beginners	Intermediates	Experts
Gender	4 Women /2 Men	2 Men / 4 Men	2 Women / 4 Men
Age groups	6 aged 21-36	4 aged 21-36 2 aged 49-67	3 aged 21-36 2 aged 37-48 1 aged 49-69 1 unknown age
Race/Ethnicity	1 Asian Indian 1 Native American/Native Alaskan 1 Korean 2 Non-Hispanic White 1 Unknown	6 Non-Hispanic White	1 Vietnamese 1 Puerto Rican 3 Non-Hispanic White 1 Unknown
Correct beer trivia answers (of 5)	3.5	4.1	4.6
Additional info	Pulled particularly from Cornell student population.	Included home-brewers.	5 participants have consumed beer for 10+ years.

Participants signed consent forms and subsequent discussions followed the leader's guide. Three samples of New York State craft beer were served, with no brand, style, or other information, and presented labeled with random 3-digit codes (Table 2).

Meetings were digitally filmed with consent of participants. Opinions from all participants were encouraged whether in agreement with the majority or not, whether positive or negative. At the conclusion of meetings participants were paid for their time. Qualitative data from focus groups is not appropriate for deriving statistically significant values, therefore only descriptive analysis will be provided.

Table 2. New York State Craft Beer Samples Used in Language and Expertise Focus Group

Brewery	Location	Beer Name	Price	Packaging	#	Bottle Date	Images
Knucklehead Craft Brewing	Rochester	Ehret's Amber Ale	$8 for 32 oz.	32 oz. Growler	810	Growler filled within 1 week of study.	
Resurgence Brewing Company	Buffalo	Amber Lager	$6 for 16 oz.	Crowler 16 oz. can	388	Canned within 3 weeks of study.	
Fairport Brewing Company	Fairport	Raider's Red	$6.85 for 22 oz.	22 oz bottle with crown cap	224	Purchased from FLX Brewing within 1 week of study.	

Results

In all three expertise levels the terms 'balanced,' 'rich,' 'citrus,' and 'local' were considered indicators of quality beer. Other quality indicators were shared across two of the three expertise levels, including 'hoppy,' 'floral,' and 'jalapeño,' from beginner and expert groups and 'pairs with food' from the beginner and intermediate groups. Words that universally had a negative connotation included 'low calorie' and flavors that were associated with the 'too sweet' concept (Table 3). The beginner and expert groups also indicated that 'banana,' and 'bitterness,' were negative signals, as was 'sour' for the beginner and intermediate groups. 'Bitterness' and 'sour' were acceptable, however, when stylistically appropriate to the beer.

Table 3. "Too Sweet" Concept Descriptors
• Peanut Butter • Raspberry • Blueberry • Pumpkin • Coconut • Maple • Caramel • Chocolate • Marshmallow • S'more

The 'too sweet' concept proved to have two distinct parts, with participants from all three expertise levels labeling these flavors both as desirable and as highly undesirable. Desirable flavor descriptors were associated with a modest amount of the flavor, a high-quality product, and a 'grown-up' marketing style that does not suggest a young or down-market target audience. Desirable beers were not described as 'sweet' themselves. Undesirable 'too sweet' flavor descriptors were associated with a constellation of other suggestive 'sweet' words like 'rich,' 'heavy,' and 'dried fruit' in descriptions, and over the top or cartoonish marketing. Participants at all three levels of expertise indicated that they drank beers that they would describe using words from the 'too sweet' descriptor list, though participants from the expert level showed the most openness to these flavors.

Participants were asked to taste and describe the three New York State craft beers described above. They self-generated terms to describe the following broad categories: visual appearance, mouthfeel, taste or aroma, and abstract qualities. Much of the language repeats over the levels of expertise, but some is distinct (Table 4).

Bottom Line

Consumers at the beginner level used the widest variety of language to describe characteristics they liked. This group used fewer words associated with 'too sweet' concepts to describe their ideal beer; members were interested in new beer experiences from trusted brands, and wanted clear information from labels or description on style and ABV.

Table 4. Sensory Descriptions of Beers by Groups with Different Levels of Expertise

	Beginners	**Intermediates**	**Experts**
Visual Appearance	Caramel Cloudy Deep color Sparkly Amber	Amber Copper Dark Clear Reddish	Jewel-tone Pale brown Clarity Filtered Cloudy
Mouthfeel	Medium-bodied Thick Tingly carbonation	Medium Mellow bubbles Thick Clean finish	Thick, creamy, lasting head Heavy
Taste or Aroma	Hint of toffee Nutty Caramel Hoppy Aromatic Savory Earthy/Rustic Sourdough pretzel Citrusy	Subtle hops Malty Vanilla Subtle fruit Coffee/Espresso Roasted Cream Spicy Piney	Malty Grain/Barley/Wheat Fruity Bitter Roasted Hoppy Sour
Abstract Qualities	Balanced Rich Festive Satisfying No-fuss Drinkable Refined	Classy Easy to drink Warming Refreshing Harvest Autumn Northwestern	Not monotonic Unique Sour Distinctive Easy to Drink Appropriate to style Not pretentious

Consumers with intermediate experience in craft beer used descriptive language that was more abstract and focused on ingredients. In this group, several panelists were home-brewers, which may be responsible for their interest in technical details; they wanted labels or descriptions to indicate the type of malts, hops, and additional ingredients used in a beer, citing interest in the brewing process, allergen concerns, and a desire for clean labeling. They expressed more concern for beers being brewed to style than any other group, and were the only group to bring up International Bitterness Units (IBU)s, the industry measurement of bitterness. The intermediate group indicated that this information was important to their assessment of hop variety, quality, and volume.

The expert group tended to use technical language similar to that used by the brewing industry. They were most conversant in beer styles, techniques, and tasting terms. This group wanted straightforward information on beer flavors, aromas, and food pairings.

Several descriptor themes were expressed as desirable among all participants regardless of expertise level, including intended style, alcohol by volume (ABV), and level of sweetness. These were considered vital to helping consumers chose a beer that they would enjoy. Short, straightforward descriptions were overwhelmingly preferred to more verbose language. Grammatical errors, misspellings, and awkward phrasing was distracting to the panelists and lowered their opinion of brands that made these mistakes. Short, common descriptive words associated with beer flavors like ‘‘roasted,’ ‘toasty,’ ‘malty,’ ‘fruity,’ ‘bitter,’ ‘citrus,’ and ‘piney’’ were preferred to novel flavor or aroma descriptors.

Regular consumers of beer use a variety of words to describe beer, and desire different information and authorial tone from breweries depending on their level of expertise. Once the expertise level of target consumers has been identified, breweries can incorporate the language that these customers use when describing their experiences, helping to optimize consumers choice, and, subsequently, increase repeat sales and customer loyalty.

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CHAPTER 3

Creating an Appealing Brewery Atmosphere for Female Customers: Respect and Quality, not Pink Labels and Condescension

Introduction

Craft breweries are a rapidly growing segment of the New York State economy, representing more than 3.5 billion dollars of economic impact in the state (Insel 2015). According to the New York Brewer's Association there were 320 breweries operating in New York State in 2016, an increase of more than 300% from the 95 breweries open in 2012. Nearly a million barrels of beer were brewed in 2013, and breweries employed the equivalent of over 11,000 people full-time; that number has only increased since (Insel 2015, The Office of the Governor 2018).

A 2017 New York State brewery survey found that the majority (58%) of New York State breweries customers were male (Wagner 2017). Nationally, women's consumption of beer is lower than men's (Kerr et al. 2004). Women's consumption of beer has fallen over the past century, with women born between 1905 and 1945 being heavier consumers of beer than those born between 1945 and 1985 (Kerr et al. 2004). A recent survey from Gallup showed that in 2017 19% of American women who drank alcohol preferred beer, compared to 62% of men who drank alcohol (McCarthy 2017). Surveys done the same year indicated that 69% of women consumed alcohol in the past year, similar to the rate for men (76.7%) (Grant et al. 2017). However, because women dominate spending on retail goods (Rowley 1999) and groceries (Nielsen 2013) breweries would be well compensated were they to better market themselves to women.

Beer is generally regarded as a masculine product (de Visser and McDonnell 2012), and sexism in beer marketing is common, so pitching beer to women presents a challenge that some large producers have failed (Mulshine 2015). Enmeshing male-gendered products like beer with

female-gendered messages result in poor reception of advertisements, as consumers experiencing dissonance view ad claims as conflicting and incongruent (Hogg and Garrow 2003). Notably, while college-aged women do identify objectionable, sexist themes in beer advertising, the objectionable material was already part of their conception of the product, so the sexist advertisements did not significantly change their likelihood of purchase (Polonsky et al. 2001).

In an effort to help New York State craft breweries access an underserved market, a series of focus groups with female beer consumers were held with female beer drinkers. Participants offered feedback on brewery atmosphere, service, and the types and number of beers served.

Methods

Three focus group sessions, each lasting 1.5 hours, were held with participants recruited from the Alcohol Sensory Panel at the Cornell Sensory Center. Participants were all women who self-reported drinking beer at least once a month. Participants were led in a guided discussion according to a pre-written leader's guide that elicited opinions on different aspects of consuming and purchasing beer and making brewery visits. Each participant was encouraged to speak and all opinions were respected and recorded. Information from these focus groups was obtained through video- and audio-taping, collecting tasting notes from participants, and group leader note taking.

Although focus groups are a common method of investigation and are informative, data obtained from these sessions is not appropriate for statistical manipulation or representation. Attempts were made to create a focus groups that represented a variety of demographics including age, ethnicity, and presence of children in the home (Table 1). Participants drew heavily from the greater Ithaca area.

Table 1. Demographics of Participants in "Women and Beer" Focus Group

	Group 1	Group 2	Group 3
Participants 21-36	3	4	3
Participants 37-48	3	2	4
Participants 49-67	2	2	0
(Total Participants)	(8)	(8)	(7)
Participant Ethnicity (Self-reported)	1 – Korean 7 - white	1- Chinese 1- Filipino 1- Filipino, Korean 5 - white	1 - African American, Black 1 – Chinese, white 5 - white
Number of Participants with Children in the Home	4	3	1

Results

Beer and Accompaniments

In the first portion of the discussion, beer was treated as primarily as a food item for consumption. Panelists were asked to describe the qualities of beers that they liked and disliked. These conversations elicited wide-ranging opinions and allowed panelists to both disagree with others and more clearly explicate their opinions and choices. Lines of questioning that would elicit specific examples were used to allow compilation of repeated terms. This includes panelist responses that addressed flavors and styles of beer, the presentation of beer for consumption on- or off-premise, and food that is served alongside beer.

Product Flavor and Style: As expected, focus group panelists represented a wide range of experience in beer drinking, exposure to different beer styles, and drinking habits. Consequently, opinions varied on what specific attributes were appealing, other than those related to general concepts of quality. Beers that were perceived as overly-sweet, overly-alcoholic, or flavored for shock-value, however, were broadly rejected (Table 2).

Table 2. Hedonic Responses of Panelists in "Women and Beer" Focus Group to Beer Flavors and Styles

Like	Dislike
• IPA, hoppy • Citrus flavors – orange, grapefruit, shandy • Seasonal flavors when appropriate – pumpkin, chocolate, peanut butter, maple • Fruit flavors – apricot, raspberry, blueberry • Many styles – Belgian, Sour, Double and Triple Bock, Porter, Wheat, and Hefeweizen	• IPA, bitter, "abused IPA" • Fruity – banana, apricot, raspberry, orange peel • Seasonal or sweet flavors – coffee, maple, pumpkin, chocolate • *Brettanomyces*-style beers • Many styles – Stout, Pilsner, Smoked Porter, Double and Triple Bock, IPA, and Sour

Smells: Participants were sensitive to smells in breweries, both good and bad. Many participants enjoyed the smell of brewing beer and liked tasting in or near production spaces. Some recalled experiences where over-powering odors from cleaning or brewing were off-putting. In these cases, the strength of the odor and the inability to place it as a food or beer smell made it unappealing.

Packaging: Glass bottles were perceived as high-quality beer packaging by all participants, though clear bottles were viewed less favorably than tinted. Consumers seemed generally aware that the color of a glass bottle is related to the development of beer flaws, with clear bottles offering almost no protection against damaging wavelengths of light (Robertson 2009). Participants liked the feel of bottles in their hands, the "crack" of opening the cap, and the freshness of bottled beer. Twist-off caps were disliked, as some participants found them difficult to open, while others didn't like the feeling of the screw-top lip.

Though opinions were mixed, cans were viewed less favorably overall. Some felt that only poor-quality beer was canned or that cans gave beer a metallic off-flavor, although nearly all modern aluminum cans now utilize an inert liner that prevents interaction of the beverage with the can (Magyarics 2012). In contrast, other participants noted that cans are more environmentally friendly, that novel and high-quality beers are increasingly released exclusively in cans, and that

cans were useful in spaces where glass is prohibited (for example, on beaches, in stadiums, or in parks). This closely aligns with the broader changes in the perception of canned beer in recent years, as both well-informed and/or nostalgic consumers have a greater acceptance for canned products.

Glassware and tap selection: When served in a brewery, pub, or restaurant setting, participants expressed a strong appreciation for glassware specific to beer style. Appropriate glasses were thought to amplify specific sensory characteristics and demonstrated that the establishment took beer service seriously. Participants also liked having a broad selection of different draft beers on tap. Draft beer was considered to be the freshest and to have the best carbonation, though some panelists noted the occasional problem with quality issues related to infrequent tap cleaning.

Food: Panelists ranked food service as generally desirable, with expectation of type and quantity set by context. A bar was expected to serve something simple, and preferably free, like popcorn or pretzels. Food trucks and in-house prepared foods were also appreciated in sit-down environments, but a plate of food was seen as a burden in standing-only bars. Similarly, participants appreciated breweries carrying a small selection of foods for consumption on premise, like local cheeses, chips, baked goods, or ready-to-eat sandwiches. Participants wanted culinarily-accessible foods, nothing too "obscure" or "hipster". Foods that were appropriate and appealing for kids in a family-friendly brewery or restaurant was a must. Food and non-alcoholic drinks appealing to underage customers and designated drivers was an important factor in planning group visits and regular outings.

Customer Service

Further discussion treated the sale of beer as a customer-service opportunity. Panelists were asked to recount specific instances of excellent and poor customer service experienced at a business where they were served beer. Because each panelist's contribution was fairly specific,

panelists were asked, as a group, to incorporate individual incidents into broader themes. Many panelists were prompted by others' stories and followed with their own in similar a vein, creating consistent motifs. This discussion included responses that addressed the interactions between customers and service staff, and different aspects of the atmosphere created in the front of house.

Making Assumptions: Panelists were uniformly critical of servers who assumed women didn't like or know much about beer. Women recounted frequent experiences with brewery servers assuming that they did not drink beer at all, only drank sweet, fruity beers, or were at a brewery at the request of their male companion (Appendix A). Such interactions made participants feel constrained from drinking what they were really interested in, unvalued as a customer, and disrespected as a person. In general, women reported being treated differently than men, and a history of negative experiences has left them sensitive to such slights.

Server Knowledge: The expertise level of servers and bartenders, and their means of communicating, came up several times in each focus group. Participants wanted their servers to be knowledgeable enough about beer to make recommendations, and able to communicate relevant information in clear, non-technical terms. As noted above, women wanted to be invited into conversation about beer and not feel that servers are speaking down to them. The desire for friendly and knowledgeable service staff was also the quality most associated with high customer satisfaction scores and greater purchases totals in the 2017 New York State Brewery Survey (Wagner 2017).

Communication: Panelists wanted lots of clear information to be offered to them in signage, menus, websites, labels, and by employees. They were interested in being presented with beer flavor descriptions, style, alcohol by volume (ABV), ingredients, hop variety, International Bitterness Units (IBU), and food pairings. Not every participant felt every piece of information was critical, but all found more information either helpful or neutral; in other words, offering more

information did not elicit negative feedback at any point. Curated flights and other guidance were appreciated, especially when many options were available. When information was not available participants became frustrated and found it harder to make decisions.

Kid/Family Friendly: When going out in the early evening or on the weekends, participants with families wanted to bring their children with them without difficulty or shaming from staff. Participants wanted basic accommodation for their families: a positive attitude from staff, space where they could sit and not be frustrating to staff or other patrons, table-top or lawn games, and, if food was served, items and portion sizes appropriate for children. These participants noted that they had become regular customers of establishments that offered such amenities. Enclosed outdoor spaces with games like Jenga, cornhole, and skeet ball made bringing families easier, prompting more return visits. Participants understood and were comfortable with the fact that certain kinds of establishments and times would never be appropriate for children, but wanted clarity and agreement between management, service staff, and customer communications on the business' policy on patrons under age 21 or 18.

Sense of Welcome: Participants liked being welcomed or greeted soon after entering an establishment, and felt it important that customers not be left waiting without being acknowledged and given instructions on ordering and service (for example: take any open seat, put your name on a list, go to the back bar for a tasting.) Clear greetings and instructions created a welcoming atmosphere, making participants feel comfortable enough to linger and make purchases. In contrast, being left in a state of uncertainty about what to do and expect was off-putting. One participant noted that she hated walking into an establishment without a clearly designated entrance door, and would even leave to avoid making potentially embarrassing errors.

In breweries where the production staff doubled as tasting room staff, participants sometimes felt as if they were interruptions to work, rather than welcome visitors. Similarly, when

breweries were very busy, participants felt like a burden on staff, which reduced their enjoyment. They also noticed when service was slow and they were left waiting, or when service to different customers was uneven. In all of these instances, participants felt unvalued as a customer, tended to leave sooner, and were more reticent to return.

Sense of Safety: Personal safety in a drinking environment was a common concern. Participants wanted to know that staff would intervene if other patrons harassed or bothered them. They also wanted the staff to have undergone sexual harassment training; as one participant put it, "Don't call me 'sweetie'." Being able to park close to the business and having entrances well-marked and lit, especially at when visiting after dark, were also associated with a sense of safety.

Tours: Tours of production spaces should give a brewery the opportunity to educate customers and make an emotional connection, but participants had been largely disappointed in tours they've experienced. Tours that were simplistic, poorly organized, or seemed to impose on production staff made participants feel disengaged, awkward, and unwanted as customers. They remained universally eager, however, for tours that are stimulating, educational, and well-managed.

Structure

The third part of the discussion addressed drinking beer on-premise as an impetus for a customer to interface with the physical structures, the brick and mortar, of an establishment. Panelists were asked to imagine an ideal setting in which to drink a beer. As panelists offered their suggestions they were questioned about influences on their preferences and, when appropriate, if these preferences applied brewery settings. This section includes panelist comments that focus on the types and qualities of the spaces that customers occupy.

Differentiation of Spaces: Participants expressed a general desire for differentiated spaces, such as outdoor areas and separation between live music and quieter places for discussion. One

participant recalled a favorite establishment that had a few very different spaces that allowed for sit-down eating, standing and socializing, and for bands playing; this allowed her to make it "her place" even when she had different needs (dinner with her parents, hanging out with friends, meeting with a professor). Participants enjoy this sense of belonging and the utility of accessing an establishment with different people at different times.

Noise Level: All three focus group sessions concentrated on an appropriate noise level as a very important factor in a drinking atmosphere. A space was too noisy if a conversation among friends could no longer take place. Crowd noise and music noise were both objectionable if they interfered with conversation. Live music that was loud was acceptable if participants had intentionally gone to the space to listen to a concert. However, if participants were at an establishment and live music was playing that they didn't expect they often didn't enjoy the musical performance. Some participants said they might leave early or try to finish their drink before the band began playing. Participants appreciated differentiated parts of a brewery or pub that were quieter or utilized sound mitigation.

Cleanliness: Perhaps unsurprisingly, cleanliness was a universally important factor. Bathrooms ranked as most important to panelists, and they wanted them to be clean regardless of how busy an establishment was or how late in the business day it was. Panelists would take note of the cleanliness of other areas including the bar top, the bar back, taps, floor, and any visible production spaces. Good practices regarding food, dish, and glassware handling also signaled cleanliness. Participants stressed that bathrooms, food handling, and clean dishes/glassware were most important to their overall assessment. This echoes earlier results indicating that clean bathrooms were an important attribute of brewery "interior appearance," related to higher customer satisfaction and spending in a brewery (Wagner 2017).

Bathrooms: In addition to basic cleanliness, panelists expected a sufficient number of bathrooms or stalls for the size of the establishment. Single-occupancy, non-gendered bathrooms were preferred, so customers could use any bathroom efficiently and without stigma. One participant noted where the line for the women's room was routed and, if it snaked somewhere strange or inconvenient, like in front of the kitchen door, she assumed the establishment didn't prioritize its female customers. Participants were very sensitive to the number and placement of women's restrooms compared to men's. When bathroom capacity was limited, participants expressed a willingness to use men's rooms, both single and multiple occupancy. The participants did not feel apologetic for breaking this social taboo; rather, they were annoyed that the establishment owners put them in a potentially awkward position.

Outdoor Space: Outdoor space was desirable to participants for a variety of reasons. Participants disliked feeling rushed when drinking, and outdoor spaces provided a relaxed atmosphere where they could be with their families, including children, and friends in an informal manner. Outdoor space also provided a more conducive area for playing games and could offer a less crowded and noisy area for conversation.

Seating: Participants prioritized comfortable seating over traditional barstools, which were considered uncomfortable because they lacked a backrest, were difficult to walk around, and could make the sitter feel crowded. The same held true with high-top tables with stools. Indoors, booths or tables and chairs were preferred, and plush, roomy seating with backrests prompted consumers to prolong their visit. Picnic tables were acceptable for outdoor seating, though some still preferred the comfort of a chair with a back. Regardless of seating type, panelists preferred that walkways be generous enough to prevent struggle and constant apologizing when moving through the seating area.

Location: Parking that was convenient and provided a sense of safety was important to participants, and the appeal of close, dedicated parking increased after dark. Some participants liked establishments that were physically close to other kinds of entertainment or businesses: theatres, shops, or other pubs, bars, or breweries. Other participants enjoyed places that were physically located near their home or work, thus reducing their travel time and creating a sense of a "third place," a concept used in the hospitality industry to denote "public places that host the regular, voluntary, informal, and happily anticipated gatherings of individuals beyond the realms of home and work" (Oldenburg, 1999).

Local: Participants were very attuned to the local products concept, which was seen as valuable. Small, independent breweries were seen as part of the locavore movement, and participants were more interested in trying local beers for variety, because they had emotional connection with the place of origin or supported small businesses. The concept of "local" was most strongly evoked when directly indicated with regional place names and local or appropriate natural imagery. There was no single definition of "local" as defined by distance from the panelist's home or community. As in previous studies, the term was elastic and relative to panelists, often extending to geographic regions or states (Oldenburg 1989).

Discussion

Though many factors that make brewery visits appealing are not gendered, breweries hoping to draw female consumers can make some targeted changes. Panelists indicated that they wanted a wide range of high-quality beers, served in a physically comfortable space by welcoming and respectful staff. Breweries can be more thoughtful about catering to women as customers in each of the areas, as explored in this study.

As a beverage offered for consumption on- or off-premise, breweries should offer a wide range of styles for varying palates and situations. Beer should be served in appropriate glassware

for beer style, or that otherwise suggests that the brewery has given thought to how service affects consumer experience. When packaging beer, whether in cans, bottles, or growlers, breweries should highlight the positives of their beer's packaging format. Breweries should strive to serve food, whether packaged or prepared on-premise, to create a welcoming atmosphere for drinkers and non-drinkers alike. Breweries can elicit feedback from customers on the appeal of individual food-items to ensure their particular customer-base is being served.

The panelists described in distressing detail poor customer service they perceived to be directly related to their gender. Establishments have a prime opportunity to build good will with female customers by focusing on training staff to make small changes, like greeting female customers in a friendly and respectful manner, giving them the same depth of information on beers as male customers, and not assuming a male companion is the reason for the visit or the one ordering the more cerebral beer. Addressing concerns that female customers have about their safety and comfort while drinking is paramount, suggesting a need to develop strong policies on sexual harassment and train employees to respond to unwanted behavior from patrons. Generally orienting employees to a customer-focused attitude regardless of their job title is important to making women feel valued and respected. Breweries should also assess their methods of communicating to customers in general, and make sure there is clarity, thoroughness, and agreement in these statements and that they are made visible or easy to access.

As panelists considered their interactions with the physical structure of breweries, several concepts were infused with particular energy: cleanliness, bathrooms, and noise-levels. Breweries should maintain a scrupulously clean production, food-prep, and bathroom areas, as these affected panelist judgement of the business and their willingness to purchase product. A thoughtful assessment of the bathrooms offered to female customers may be valuable. If additional bathrooms cannot be added, or inconveniently placed ones moved, due to expense or limitations of the space,

other methods of improving the user experience should be considered, such as improved lighting and signage, updating fixtures, and hanging clever bathroom art. When hosting large events that would overwhelm their own facilities breweries, should bring in portable toilets if space allows. If a brewery finds that their spaces are overly loud, they can mitigate this with small changes like turning down music, adding soft furnishings, and breaking up large spaces with noise absorbing or scattering fixtures.

Advice from women

When asked to provide advice directly to owners of breweries, pubs, and bars, participants responded:

- Put purse hooks up under the bar.
- Have novel and special beers that are only available at the brewery.
- Treat bathrooms with care throughout the day.
- Employ both men and women in all parts of beer production.
- Employ women who are interested and enthusiastic about beer.
- Treat female staff with respect. Panelists said they noticed when female employees were in exploitative or manipulative workplaces, and empathized with them.
- Staff should be knowledgeable, well-trained, and good communicators; if they don't know all the beers, they shouldn't be the first point of contact with consumers.
- Don't be condescending with clumsy attempts to directly court women. Ladies' nights, putting calories on the bottle, pink and purple labels, flowers- these things are obvious and feel targeted. Focus on appealing to educated consumers, and assume women are part of that group.

Conclusion

Women are under-represented as consumers at New York State's regional breweries, and therefore represent an opportunity for market expansion. Women didn't want to be targeted with traditional 'feminine' marketing gimmicks, but instead expressed a strong preference to be treated as if their interest and tastes were the same as male patrons. Panel participants showed interest in the same range of beer types and sensory profiles and noticed when employees made assumptions about their knowledge or preferences that seemed influenced by their gender. In fact, participants were in greatest agreement on conceptually gender-neutral, general customer-satisfaction metrics, and expressed desire for good quality beer, respectful and welcoming service, comfortable space, and a clean premise. Generally, focus group participants had very positive feelings around the New York State brewing industry and were optimistic that breweries would continue to make them feel increasingly welcome.

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APPENDIX A

Quotes from participants about "Making Assumptions"
Interjections from other participants in parenthesis.

- *I get really frustrated when people assume I don't like beer, it's almost like, don't assume you have to sell it to me. If I'm out with a guy and he orders not-a-beer and I order a beer they will give the beer to him. (That's a good point, that's an excellent point!) I…like…beer…too.*
- *I went into a bar over vacation and the bartender asked me what kind of wine I wanted (Really? You're kidding! I'm surprised he didn't offer you a Chardonnay!) I mean, I will have a wine, but I like beer.*
- *Don't make assumptions, about anybody, about anything! Treat all humans the same…*
- *Say I'm in the mood for a fruity beer but now I feel like I can't order one because then I'm the woman who drinks fruity beer and not real beer, so if I was hoping to have a raspberry beer I'm not going to order one because...*throws hands up in frustration.**
- *Don't have servers assume that I know absolutely nothing, I ask for recommendations and they list two very basic things.*
- *Train your staff, especially your male staff, to be respectful of women and not to treat women as if they don't know anything about beer and to make them feel as welcome in this space as men.*
- *Don't assume we all like fruity beer (laughter) we have a wide range of tastes just like men do.*
- *Don't assume my male companion is why I am there.*

CHAPTER 4

The Appeal of Different Aspects of Beer Labels to Female Beer Consumers

Introduction

Beer marketing has long been plagued with sexism (Towns, Parker, and Chase 2012) with a history of female models in revealing bathing suits, women portrayed as ditzy or submissive, and men behaving in a sexually aggressive manner. While beer advertisement trends are changing, sexism is still evident. Some recent advertisements, even by large corporations with resources for market research and testing, have elicited public outcry for being tone-deaf and sexist (Mulshine 2015).

Because beer is conceptualized as a masculine product (de Visser and McDonnell 2012), research suggests that a sense of incongruity is created when it is marketed in a feminine way (Hogg and Garrow 2003). Marketing beer to women is also complicated by the fact that women have been found to think more critically about ad content, asking deeper and more abundant questions about the products and characters portrayed (Ulrich 2013). Despite this, college-aged women shown a sexist ad for beer identified the sexist themes and were offended by them and yet didn't change their intention to purchase the beer. This suggests that a certain amount of negative feelings and sexism are built into the concept of some beer brands, and perhaps beer as an overall category (Polonsky et al. 2001). If breweries want to market themselves and their products to women, they may increasingly face particular obstacles in creating advertisements that appeal to a critical audience with entrenched ideas about their product.

While research into women's opinions about beer and advertising more generally can give some direction to New York State breweries, understanding the opinions of local female consumers can offer more detailed and actionable information. This focus group provided insight

into how women residing in New York State react to different styles of beer marketing in an effort to aid breweries in optimizing beer labels and other marketing materials for the growing female market for beer.

Methods

Three focus group sessions, each 1.5 hours long, were held with participants recruited from the standing Alcohol Sensory Panel at Cornell's Sensory Evaluation Center. Participants were all women, largely from the greater Ithaca, NY area, who self-reported drinking beer at least once a month. Attempts were made to balance groups by age, ethnicity, and the presence of children in the home, see *Table 1. Demographics of Participants in "Women and Beer" Focus Group* in Chapter 3 above. Panelists were led in a guided discussion designed to elicit opinions on different aspects of purchasing and consuming beer, and on brewery visit experiences. Each participant was encouraged to speak, and all opinions were respected and recorded.

During one part of the session, participants were presented with eight commercially-available New York State beers, seven bottled and one canned, purchased in May 2018, see Table 1. Prior to group discussion, participants were asked to individually examine and rank beer packaging from their favorite (1) to their least favorite (8), without consideration of their preference for the style of the beer itself.

For this work, beer labels were used as a proxy for marketing in general, as they represent the most common form of brewery marketing, are viewed by a majority of beer consumers, and could be physically presented to participants of the focus group. Breweries produce a variety of flyers, brochures, and printed advertisements, but labels are used consistently, and can be easily compared across producers. Although not all New York State breweries produce bottled or canned products, a sufficient range could be acquired to represent the wide variety of advertising styles commonly used in the state. No single marketing rubric allowed researchers to sort beer labels by

content, intended audience, and style, so labels were chosen to represent characteristics and concepts of a wide range of the current market, including the presentation of information to the consumer, representative artwork and geometric designs, naturalistic and local imagery, and figural representations of men and women (Table 1). These choices were inherently subjective. It is important to note that while focus groups are a common investigation method and provide informative data, such data is not appropriate for statistical manipulation or representation.

Table 1. Characteristics of Beers for Label Investigation in "Women and Beer" Focus Group

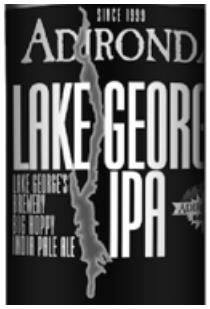
Beer	Label characteristics	Style	Brewery	Location
Coast-to-Coast IPA	Blue/Greens, Geometric, Non-representational	IPA	Brown's Brewing	North Hoosick, NY
Cross Section IPA	Yellow/Green, Linear, Geometric, "NY Brews" logo	IPA	Wagner Valley Brewing Co	Lodi, NY
The Kind	Colorful, Artist rendered, Hippie and Buddhist imagery, Male figure	IPA	Three Heads Brewing	Rochester, NY
Lake George's IPA	Black and bright green, Large type, Lake image	IPA	Adirondack Brewing	Lake George, NY
Legacy IPA	Colorful, Artist rendered, Naturalistic and mythic imagery	IPA	Saranac Brewery	Utica, NY
Mow Master	Colorful, Lawn care imagery, Linear/blocky style	Ultra Pale Ale	Ellicottville Brewing Co.	Ellicotville, NY
Summer Ale	Primary colors, Utilizes Brooklyn Brewery's logo prominently, rippled water texture	Pale Ale	Brooklyn Brewery	Brooklyn, NY
Wailing Wench	Purple/grey, Sexualized female figure, Computer generated	Ale	Middle Ages Brewing	Syracuse, NY

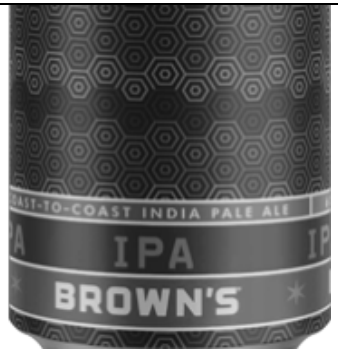
Results

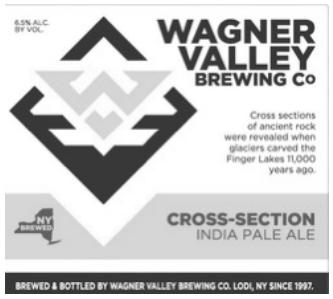
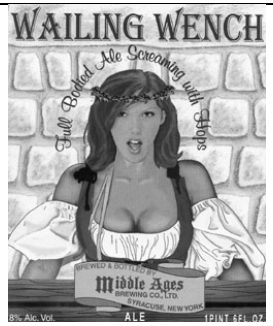
Of the eight labels evaluated, six grouped tightly, with average rankings ranging from 4.1 to 4.8 (Table 2). Adirondacks Lake George IPA, with its emphasis on locale and dramatic font, was most preferred, earning an average ranking of 2.6. In contrast, Middle Ages Brewing Co's Wailing Wench was the lowest ranked, averaging 7.2. All participants voiced dislike for its sexual connotations. When probed, approximately half of participants indicated that even if they already knew they enjoyed Wailing Wench beer that the packaging would prevent them from purchasing it.

Brown's IPA was the most controversial, inspiring a lot of conversation. Some participants felt the range of cool colors and repeating geometric design were novel, interesting, and appealing, while others felt that it no longer looked like a beer. Some worried it could be mistaken for soda by a child. A number of participants stated they were "can-averse," regardless of the contents. Some participants did not like cans because they felt they could give beer a tinned or metallic off-flavor. In contrast, some participants felt that cans were a new, modern trend and could indicate a high-quality brewery that moved with the times. Cans were also associated with greater portability and environmental friendliness.

Table 2. Beer Labels, Preference Ranking (n=23), and Positive and Negative Comments

Beer	Average Rank between 1-8 (Standard Deviation)	Positive Comments	Negative Comments
 **Adirondack Brewery** Lake George's IPA	2.625 (2.02)	Simplicity: - Easy to read typography Local emphasis: - 'Adirondacks' & 'Lake George' - Lake image - Location of brewery reflected in label Color: - Small perceived errors in different shades of green suggested small brewery; added to charm	
 **Saranac** Legacy IPA	4.125 (1.54)	Local Imagery: - nature scene was appealing - Some participants had personal connections to Saranac Lake or Saranac brewing and the connection increased their rating	Classic Approach: - Participants generally found this label unexciting or unremarkable

 **Brooklyn Brewery** Summer Ale	4.125 (1.96)	Simplicity: - Easy to recognize Source appropriate: - Font is very "Brooklyn" - Pool/water texture says "summer ale" Local -Personal connections to Brooklyn increase appeal of label	Classic Approach: - Participants generally found this label recognizable but unexciting and out-dated
 **Three Heads Brewing** The Kind IPA	4.166 (2.18)	Creative and Colorful: -Looks interesting and clever, which is an encouragement to buy -Generally positive reactions to the colorful and unique artwork	Busy: -"Took a while to figure out what kind of beer it is, who made it, everything"
 **Brown's Brewing** Coast-to-Coast IPA	4.375 (2.56)	Creative and Colorful: -Positive qualities about the design - geometric, "oceany", psychedelic, art deco, Millennial design, and cute -"Love the colors, artsy but simple" -"Like color, like design, especially for a brand name like Brown's" Clear Communication: -"I like fact that you can tell who makes it and what kind of beer it is – boom"	Creative and Colorful: -"Kind of miss a logo to rally around" -Packaging was "busy" Product Confusion: -"looked like Sprite," -"looked like Wal-mart brand soda"

 **Ellicottville Brewing Co** Mow Master	4.583 (1.93)	Appealing Tasting Notes: -Participants like taste words like "crisp and bright" being displayed prominently -Some participants liked the clarity of when you are supposed to drink this beer	Product Confusion: -"Looks like a lawn product, Ellicottville even sounds like Scottsville" -"Clever [name] but doesn't work." Unclear Communication: -"Is it a guy or a girl? Looks like an advertisement. It's hard to read, the mow master is in the middle"
 **Wagner Valley Brewing** Cross-Section IPA	4.792 (2.30)	Simplicity: -"Put thought into their brand but care more about their beer… when a label is too busy takes the focus off their beer" -"Looks craft, local, small" Clear Communication: -Lots of information is provided - "NY Brewed" prominently displayed	Product Confusion: -Interesting or attractive design, but inappropriate for a beer bottle – comparisons made to wine labels, a PowerPoint presentation, and a Material Safety Data Sheet. Classic Approach: - Unexciting imagery -Unappealing colors
 **Middle Ages Brewing Co.** Wailing Wench Ale	7.208 (1.14)		Exploitative Sexuality: - Woman's facial expression and exposed breasts make it seem marketed to men and not women - Embarrassing to purchase or drink, even ironically -Double-entendres of 'full bodied' and 'screaming with hops' considered over the top -Seen as derogatory

Discussion

No participants lamented the lack of a "ladies beer," or a label aimed at women. When asked how breweries could market their products more effectively to women, participants suggested that conscientiously 'feminizing' labels with 'pinks and purples' and flowers isn't necessary. Because beer is already gendered male in US culture, dressing it up as particularly feminine wasn't viewed positively by participants, but rather a manipulative and obvious attempt to raise revenue. Like female wine consumers, female beer consumers are guided by a wide range of factors when choosing a beer to purchase (Caputo 2003); visual interest, taste descriptions, and a connection to a place or brand are all important. A sense of understanding and enthusiasm, as opposed to grudging acceptance, for women as consumers is widely desired. Instead of wanting products that are wildly different than what are being currently marketed, participants in this focus group often reacted quite positively to some current marketing methods. Other methods, like those that were perceived to be used to lure male consumers, were roundly rejected.

Participants were strongly attracted to naturalistic imagery and regional and natural place names. Natural imagery can include photography, artist renderings (drawings, paintings, sketching, etc), maps, icons of natural objects like mountains or rivers, and people engaging with nature. Labels like Legacy IPA from Saranac Brewing and Lake George's IPA from Adirondack Brewing made nature imagery front and center, with either a lake scene or a map image of a lake and an icon of a mountain range. Each of these lakes are presumably the eponymous lake of the brewery or beer. Studies have shown that nature imagery evokes the same positive feelings in consumers that the actual natural scenes do, influencing people to connect the imagery with their own positive recollections (Hartmann 2016) and to recall the product longer (Hartmann, Apaolaza, and Alija 2013). Participants brought up specific connections they had to the locations mentioned on the label which increased their positive feelings toward the product; for example, the participant

who had gotten married at Lake George ranked the Adirondack Brewing beer first. Even when participants got the nature imagery confused factually, it still seemed effective at increasing their positive feelings. Participants misidentified the map of Lake George as a lake in the Finger Lakes or as a river, but still found it appealing. Natural imagery, when it fits with the larger branding scheme of a brewery, is a way to appeal to a consumer's own positive memories and to remain in their memories longer.

Legacy IPA and Lake George's IPA also invoke the concept of 'local' through their natural imagery, as that imagery is based on real locations. Cross-Section IPA from Wagner Valley Brewing Co also declares its local roots by using the "NY Brewed" icon, and Brooklyn Brewery's Summer ale does the same by using the borough's name and a classic New York City font. Participants in the focus group responded well to the concept of local, seeming to accept any New York State beer's claim that it was local as positive. In marketing research it has been found that the concept of local can be expanded as far as the level of the state, and that women tend to respond more favorably than men (Cholette et al. 2013). When comparing alternative food characteristics it has been found that consumers are more willing to pay a premium for "local" apples over "organic" ones (Wirth, Wiley, and Stanton 2012). No negative associations or reactions were elicited by using language or imagery that made a "local" connection. Stating "NY Brewed" within an image of New York State, listing the town or region the region the brewery is located in prominently, and utilizing local imagery like landmarks, famous residents or events, or natural scenes will work to engage the concept of 'local' for a beer.

Participants were generally turned off by the overtly sexualized figure and language on Renaissance Brewing's Wailing Wench Ale label. Such language and imagery was interpreted as disrespectful to women as customers and an indication that women were not the intended consumers of the beer, which prompted a cool response to the product. Participants felt that strong

or juvenile sexual imagery could also indicate a poor-quality beer sold on the shock value of its packaging. Participants cited several negative impressions associated with overt or inappropriate sexualization, saying, "Associating alcohol and sexuality is bad news," "I don't feel comfortable being looked at like that," and "It would have to taste very good, be my favorite beer, for me to be ok with have that in my fridge, with people seeing that when they came over."

Participants indicated that they generally enjoyed colorful and novel packaging, describing it as "eye-catching" and "fun," and saying that it helped a product stand out on shelf. Bright colors and updated designs were appealing because they communicated the hedonic and pleasurable nature of the product. Participants were sometimes looking for a beer that would simply be fun, and the more colorful and intricate labels expressed that concept. The Kind IPA from Three Heads Brewing and Coast-to-Coast IPA from Brown's fell into this category. Generally, people did not have negative reactions to the labels on these bottles, though the labels were not equally persuasive to everyone, and some participants reacted quite negatively to cans as a packaging choice. Puns and creative word-play in the name of the beer was appreciated. Labels should not veer into the "cartoonish" or "childish," however, as this was associated with either low-quality beers or those flavored for shock-value.

Many participants were knowledgeable beer drinkers and described wanting a beer label to communicate as much information as possible. Participants indicated they were interested in seeing flavor description, style, ABV, ingredients, brewery, hop variety, IBU, and suggested food pairings on beer labels. There was no obvious penalty when a label included information that a participant felt was extraneous, but participants were frustrated when a label made finding information difficult, for instance if important information was in a difficult to read font, as in the beer style on the Mow Master from Ellicottville Brewing Co. On the other hand, offering an abundance of information, like that of Cross-Section IPA from Wagner Valley Brewing, even to

the perceived detriment of style, was appreciated by participants who put the highest value on knowledge. Two participants noted the "clean," and "easy to read" design of the Cross-Section IPA, and both rated it first and noted the abundance of information about the beer offered on the label.

Conclusion

As a group, female participants found some label attributes overwhelmingly appealing or off-putting. Using this information, New York State breweries can make more educated design decisions to reach female consumers. Natural and local imagery and language had overall positive effects and should be considered by breweries when it makes sense within their marketing strategy. Bright, colorful, funny labels were often appreciated if juvenile humor was avoided. Breweries should strive to provide as much information about their beer as possible in a clear typeface to meet the demands of knowledgeable consumers. Labels that utilize overt sexualization, especially of female figures, should be avoided, as these alienate female consumers.

Future studies could utilize a more controlled approach in offering labels created specifically for the focus group to represent different themes commonly evoked in beer marketing. This could reduce contamination of opinions by previous exposure to products, others' opinions, and feeling about products that were not related to the marketing.

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CHAPTER 5

Comparing Anthocyanin Profiles of Six Interspecific Hybrid Grapes and *V. vinifera* cultivars, Pinot Noir, and Lemberger

Introduction

The color of red wine is created by anthocyanins, phenolic compounds in the flavonoid group (Ozeki et al. 2011). This family of compounds are found widely in nature, and contribute to color throughout a plant (Ozeki et al. 2011). The color of anthocyanins is created by the conjugation of the triple ring structure, which absorbs green light in the 520 nm wavelength, giving it a reddish appearance (Waterhouse, Sacks, and Jeffrey 2016). Non-glycosylated anthocyanins, called anthocyanidins, are rarely found in wine because they are highly reactive and quickly degraded (Waterhouse, et al. 2016). Instead, mono- and diglycosylated anthocyanins predominate. Five species of anthocyanins are most commonly found in grape berries: cyanidin, delphinidin, malvidin, peonidin, and petunidin (Buren et al. 1970).

The anthocyanin profile of many commercially important grape cultivars, both *vinifera* and non-*vinifera*, have been identified, and can be distinct enough to determine the authenticity of certain label claims (Geana, et al. 2011; Burns et al. 2002). Pinot Noir has long been known to lack acylated anthocyanins, a trait so regular that it can be used to tell genuine Pinot Noir from fraudulent (Fong, et al. 1971). *Vitis vinifera* grapes primarily have monoglycosylated anthocyanins, while diglucosides are associated with grapes with non-*vinifera* parentage (Picariello et al. 2014). Interspecific hybrids, depending on the extent of their *V. vinifera* parentage, can have a wide range of mono- to diglucoside ratios (Picariello et al. 2014).

Cultivars vary not only in the more general grouping of mono- and diglycosylated anthocyanins, but in the concentrations of individual anthocyanin species (Koyama et al. 2017). These anthocyanin ratios are like fingerprints, and can identifying characteristics of individual grape cultivars (Burns et al. 2002). Further, anthocyanin species reflect different colors, and anthocyanins available in grape juice ultimately affect the overall color of finished wine (Burtch, Mansfield, and Manns 2017). The color values of anthocyanins depend significantly on the pH of their solution (Waterhouse, et al. 2016), meaning that malvidin-3-glucoside, usually the most abundant anthocyanin, will contribute a red color at common wine pH, and delphinidin-3-gucoside will contribute more bluish color, in their un-complexed or polyphenolic form (He et al. 2012). Ultimately, a wine's color reflects the combination of anthocyanin species present in solution.

The anthocyanin content of grapes will affect the trajectory of the subsequent wine's color throughout aging. Monoglucoside anthocyanins are more susceptible to reactions that create stable pigmentation, including co-pigmentation, polymerization, and the creation of pyranoanthocyanins (He et al. 2012). Diglucoside anthocyanins are more frequently subject to bleaching by bisulfites, water, or other nucleophiles which disrupt the three-ring conjugation (Waterhouse, et al. 2016). Wines with a high proportion of diglycosylated anthocyanins tend to develop undesirable color with aging (Alcalde-Eon et al. 2006). The second glucose moiety in diglycosylated anthocyanins, located the C5 position, blocks the creation of pyranoanthocyanins, so wines with high concentrations of these kinds of anthocyanins do not develop the brick-red color associated with aging in quality red wine (He et al. 2012). Wines with high ratios of di-glycosylated anthocyanins are both more likely to lose color saturation and to fail to develop the commercially desirable brick-red color, instead retaining the blueish hue exhibited in young wines (Lago-Vanzela et al. 2014). The ratio of mono- to di-glycoslylated species may determine how commercially viable

the wine produced from a particular grape cultivar is because the visual aspect of red wine is so important.

Winemakers and consumers have expectations, articulated or not, for certain hues and color saturations in their wine. This desire for specific visual qualities of wine can be seen in the way wine writers speak about color in language that is both extremely evocative and yet rigidly defined by the wine industry (Paradis 2010). Commercial use of products such as mega-purple (Canandaigua Concentrates, Madera, California), made from the *V. vinifera* cultivar 'Ruby Red,' to achieve dark red colors in finished wine also shows the commercial value of specific *vinifera*-centric hues (Berger 2006). Winemakers are not usually supplied with information about the anthocyanin profiles of the hybrid grapes they choose to work with, and must intuit each hybrid's color qualities from their own experience. With appropriate information, vineyard managers and winemakers can choose cultivars with anthocyanin profiles that will produce the desired color in finished wine, change color in a pleasing way as the wine ages, or will have an appropriate density of color for dosing poorly colored wines.

Grape-breeders make their decisions about what cultivars to propagate by understanding which cultivars are currently valued by industry and what qualities prompt this valuation (Wang et al. 2017). Commercial acceptability of color would be more easily propagated if a cultivar's anthocyanin profiles were better understood. Development of new hybrids that meet the color needs of winemakers by determining the likely anthocyanin profile ahead of time would save grape-breeders wasted effort.

This project characterized profiles of single samples of grape cultivars which were averaged to create a fingerprint-like identity independent of specific vineyard, cultivation practice, or vintage. Anthocyanins were isolated from plant material (Kim and Lee 2001), then analyzed in an HPLC and the anthocyanins identified and quantified (Manns and Mansfield 2012).

Materials and Methods

Berry Skin Preparation

Six inter-specific hybrid cultivars (Maréchal Foch, Arandell, Noiret, Marquette, Frontenac, and Chambourcin) were selected for their commercial value to wineries in New York State and other cooler-climate regions. Two *V. vinifera* cultivars (Pinot Noir and Lemberger) were selected for their extensive plantings and previous study. For each cultivar, 100 berry samples were selected at the time of harvest (>18° Brix) at commercial vineyards and research plots throughout the Finger Lakes region. Size of vineyard, layout, and tons per acre varied by location and variety, therefore efforts were made to sample from as many of the rows as reasonable, for example 10 rows from a 15 row planting or all rows from a three row planting. Samples were taken from both sides of the rows, inside and outside of the canopy, and from all parts of the grape cluster. No diseased, visibly under-ripe, or otherwise malformed berries were sampled. Berries were sampled directly into labeled Ziploc bags and transferred into a cooler with blue ice for transport from the vineyard to the laboratory freezer at -15°C.

Berry samples were allowed to thaw at room temperature for approximately 5 hours until soft to the touch. The samples were weighed using a Mettler PJ300 scale (Columbus, OH), recounted, and excess berries excluded if present. The flesh of the berries was ejected from the skin by placing the berry between the thumb and the first finger and exerting light pressure. The skins were collected into a 50mL plastic test-tube, tightly capped with a screwtop lid, and returned to the freezer in an aluminum foil envelope to prevent photodegradation. The flesh was macerated and the resulting juice was extracted to take a Brix reading using an Anton Paar densitometer (Graz, Austria) (Table 1).

Table 1. Berry Sample Characteristics

Sample Code	Sampling Date	Fresh Weight (g)	Brix at Sampling	Weight of Freeze-Dried Skins (g)
17Foch1	U/A	99.06	18.2	3.39458
17Foch2	9/23/2017	126.74	21.5	5.33501
17Foch3	9/22/2017	128.69	19.9	5.49800
17Aran1	9/25/2017	121.27	19.7	5.10778
17Aran2	U/A	190.49	17.1	4.72909
17Noir1	U/A	195.02	17.5	11.18981
17Noir2	10/6/2017	183.18	17.7	9.35117
17Noir3	9/26/2017	173.32	16.5	7.28689
17Marq1	9/22/2017	118.56	22.6	5.91900
17Marq3	9/16/2017	121.65	22.8	5.29300
17Fron1	10/14/2017	123.65	22.7	5.53974
17Fron2	9/14/2017	112.01	19.7	4.20914
17Cham1	U/A	201.95	19.9	8.38494
17Cham2	10/31/2017	244.82	21.0	9.47539
17Lemb1	9/27/2017	206.74	19.3	11.05003
17Lemb3	9/26/2017	150.51	20.6	10.57993
17Pino1	9/27/2017	153.59	20.5	9.82103
17Pino3	9/26/2017	118.71	19.2	7.79800
16Noir1	10/16/2016	148.07	20.6	9.07325
16Marq1	9/15/2016	130.52	23.5	5.53347
16Marq2	U/A	148.87	26.8	6.56156
16Fron1	U/A	129.62	24.8	4.70465
16Cham1	10/4/2016	183.26	22.7	7.1008

Foch = Maréchal Foch
Aran = Arandell
Noir = Noiret
Marq = Marquette
Fron = Frontenac
Cham = Chambourcin
Lemb = Lemberger
Pino = Pinot Noir
17 = Harvested in 2017
16 = Harvested in 2016
U/A = Specific date unavailable

Grape skins were prepared and anthocyanins extracted by the method, "Ultrasound-Assisted Aqueous Methanol Extraction of Polyphenolics" laid out in *Current Protocols in Food Analytical Chemistry* (Kim and Lee 2001). This method was chosen because it provided a method for working from fresh plant material. Grape skins were spread out in a single layer on trays and freeze-dried on a 25-hour cycle. After the cycle was complete skins were returned to new 50ml, screw-capped, plastic test-tubes which were placed in aluminum foil to protect them from light. Dried skins were weighed using a Fisher Scientific Electronic Balance, Model ACCU-124D Dual

Range (Columbus, OH). Dried skins were pulverized using a Retsch Mixer Mill MM (Wuppertal, Germany) ball mixer at 25 rev/sec for 90 seconds. If skins were not homogenously powdered, samples were re-ground at the same settings. Capsules and ball were cleaned with methanol and allowed to air dry between each sample. Powdered samples were funneled into to 25mL plastic tubes, tightly capped with a screwtop lid, and returned to the freezer in an aluminum envelope to shield the samples from light.

Methanol Extraction

Samples were removed from the freezer one at a time to prevent light and heat damage. Using a Fisher Scientific Electronic Balance, Model ACCU-124D Dual Range (Columbus, OH, USA), 3g of powdered sample was weighed into a foil weigh boat. This was put into a 250mL Erlenmeyer flask and the weigh boat was rinsed with a 50mL aliquot of an 80% HPLC-grade methanol (British Drug House, Bridgeport, NJ, USA) solution, also returned to the Erlenmeyer flask. The flask was covered with parafilm and kept in a dark ice-bath. When two flasks were prepared they were moved to the Bransonic CPXH sonicator (Danbury, CT, USA) and sonicated for 20 minutes. The sonicator water bath was partially filled with ice and covered with aluminum foil to exclude light. After sonication the sample solutions were filtered through a Buchner funnel with a #2 filter using vacuum power from in-laboratory pipes. The receiving flask was also wrapped in aluminum foil to protect the filtrate from light. Filtrate was funneled into a series of 50mL screw-capped plastic test-tubes, which were protected from light with aluminum foil, and placed in the freezer. The resulting filter-cake was rinsed with a 25mL aliquot of 80% HPLC-grade methanol solution then returned to the Erlenmeyer flask with a 50mL aliquot of 80% HPLC-grade methanol solution. Sonication, filtering, and rinsing was repeated.

If frozen, filtrate was thawed overnight in the refrigerator, protected from light. Filtrate was moved into a round-bottomed flask and a 25mL aliquot of 80% HPLC-grade methanol

solution was used to rinse the plastic, screw-topped test-tubes so that all possible anthocyanin compounds were retained. The filtrate was reduced using a ValueVap RE-502 rotary evaporator (Baltimore, MD, USA) where the water bath was set to 38°C, the pressure at 25 kPa, and the rotation at a moderately fast speed. The filtrate was protected from light using an aluminum foil tent over the water bath. The filtrate was reduced to between 10-25mL, diluted back to 50mL using Type 1 water produced with a Sartorius Type 1 water generator (Gottingen, Germany) and returned to a plastic test-tube in the freezer.

Solid Phase Extraction of Anthocyanins

Separation of the anthocyanins from the methanol extraction and subsequent analysis by HPLC utilized a verified protocol (Manns and Mansfield 2012). This protocol was chosen for producing the most clear and well-separated chromatographs. Samples were thawed overnight in the refrigerator, in batches of 8, and protected from light. After thawing, samples were shaken by hand and sonicated for 5 minutes in an ice bath. A 2mL aliquot of the sample was applied to the Solid-Phase Extraction cartridges 60 mg Oasis HLB (Waters, Milford, MA, USA) under light vacuum pressure. These SPE cartridges were pre-conditioned with 3ml 100% HPLC-grade methanol and subsequently with 3ml HPLC-grade 0.01 N HCl . Once the sample was thoroughly filtered, 2ml HPLC-grade 0.01 N HCl was applied to elute sugars and organic acids. This elution was discarded and cartridges dried under light vacuum for 5 minutes. Monomeric compounds were eluted with 40mL acidified acetonitrile (Fisher Scientific, Fair Lawn, NJ, USA) solution (95:5 HPLC-grade acetonitrile: HPLC-grade 0.01 N HCL) and captured in round-bottomed glass test-tubes. This elution was dried under a continuous nitrogen stream in a 40° Fisher Scientific Model 2320 (Marietta, OH, USA) water bath. The dried material was rinsed three times with 3mL portions of HPLC-grade ethyl acetate to dissolve and remove non-anthocyanin monomeric compounds. The rinsate was discarded and the solid material dried again under nitrogen stream

in a water bath. When dry, the anthocyanin extract was dissolved in 1mL 0.01N HCL and passed through a 0.2 µm polyethersulfone (PES) filter (Krackeler Scientific, Inc., Albany, NY, USA). Samples were either immediately analyzed in the HPLC or frozen at until analysis was performed. Duplicate extractions were made of each sample.

HPLC Analysis

Prepared samples were analyzed on an Agilent 1260 Infinity series HPLC (Agilent Technologies, Santa Clara, CA, USA) using a Kinetex core–shell columns (Phenomenex, Torrance, CA, USA) 100 mm × 2.1 mm pentafluorophenyl (PFP) column packed with 2.6 µm diameter particles with a 100 å pore size fitted with an inline Krudkatcher guard filter (Phenomenex Torrance, CA, USA) HPLC settings and elution gradient are listed in Table 2.

Table 2. HPLC Conditions and Settings for Analysis of Anthocyanins in Grape Samples

Mobile Phase A	H2O:H3PO4 (99.5:0.5)
Mobile Phase B	MeOH:H3PO4 (99.5:0.5)
Injection vol.	5 µl
Flow Rate	0.2 ml/min
Min/Max pressure	135/175 bar
Column temp	45°C
Run time	30 min
Post time	10 min
Elution Gradient	
Min	*%B*
0	15
15	30
25	60
27	60
30	15

Malvidin-3-glucoside and malvidin-3,5-glucoside standards were diluted from pure anthocyanin samples purchased from Sigma Aldrich (St. Louis, MO, USA). Dilutions of 100 ppm, 50ppm, 10ppm, 5ppm, 1ppm, and 0.1ppm were made using Type 1 water. Standards were filtered through a PES filter and analyzed using the same HPLC settings as samples.

Identifying and Quantifying Anthocyanins

Retention indices were created using validated data from a previous study (Manns and Mansfield 2012) by taking the retention time for each anthocyanin and dividing monoglucosides by malvidin-3-glucoside and diglucosides by malvidin-3,5-glucoside. Retention indices are presented in Table 3. The average retention time of both types of malvidin standards were found and compared to each chromatogram to determine which peaks were malvin-3-glucoside and malvin-3,5-glucoside. The retention time of every other peak on the chromatogram was divided by the retention time of the peaks designated as malvin-3-glucoside and malvin-3,5-glucoside, and these index numbers were compared to the index numbers created by the validated data and information from standards to identify each peak.

Table 3. Retention Indices for Common Grape Anthocyanins

Anthocyanin	**Retention time (min)**	**Index Value**
Del-3-Glu	8.957	0.484686147
Cyn-3-Glu	6.318	0.341883117
Pet-3-Glu	14.19	0.767857143
Peo-3-Glu	16.35	0.88474026
Pel-3-Glu	13.67	0.739718615
Mal-3-3Glu	18.48	1
Del-3,5-Glu	4.203	0.333571429
Cyn-3,5-Glu	6.318	0.501428571
Pet 3,5-Glu	8.463	0.671666667
Peo-3,5-Glu	10.77	0.854761905
Mal-3,5-Glu	12.6	1

Cyn = Cyanindin
Del = Delphinidin
Mal = Malvidin
Pel = Pelargonidin
Peo = Peonidin
Pet = Petunidin
Glu = Glucoside

Quantification of the anthocyanins utilized the standards in a similar way. On the HPLC chromatogram, each peak identified as a monoglucoside was compared to the malvidin-3-

glucoside standard and all diglucoside peaks compared to the malvin-3,5-glucoside standard. The area under the curve of these peaks was related to the curve established by the standards.

Statistical Analysis

Least square means and Tukey tests were used to test for significance on JMP Pro 14.

Results

The mono- and di-glucosidal forms of malvidin, peonidin, and petunidin were identified in several cultivars. Anthocyanin make-up of sampled cultivars are presented in Appendix A, both as concentration in parts per million (ppm) for quantification (which does not include unidentified anthocyanins), and as percentage of total anthocyanins (which does include unidentified anthocyanins.) Figure 1 presents the mean of these values for each cultivar, with error bars representing standard deviations; these data represent an average profile of each cultivar for the Finger Lakes AVA for 2016-2017, where two seasons of sample data was available, and the 2017 vintage when 2016 data was unavailable.

Anthocyanin Profiles

The diglucoside form of cyanidin and delphinidin were not identified in any sample in this study. Hybrid cultivars had a greater variety of anthocyanins than *vinifera*, and three hybrids, Chambourcin, Frontenac, and Noiret, possessed every anthocyanin identified. Arandell lacked cyanidin-3-glycoside, Marquette cyanidin-3-glucoside and peonidin-3,5-glucoside, and Maréchal Foch, cyanidin-3-glucoside, peonidin-3,5-glucoside, and petunidin-3,5-glucoside. Pinot Noir and Lemberger each had the same four anthocyanins identified, malvidin-3-glucoside, petunidin-3-glucoside, peonidin-3-glucoside and malvidin-3,5-glucoside.

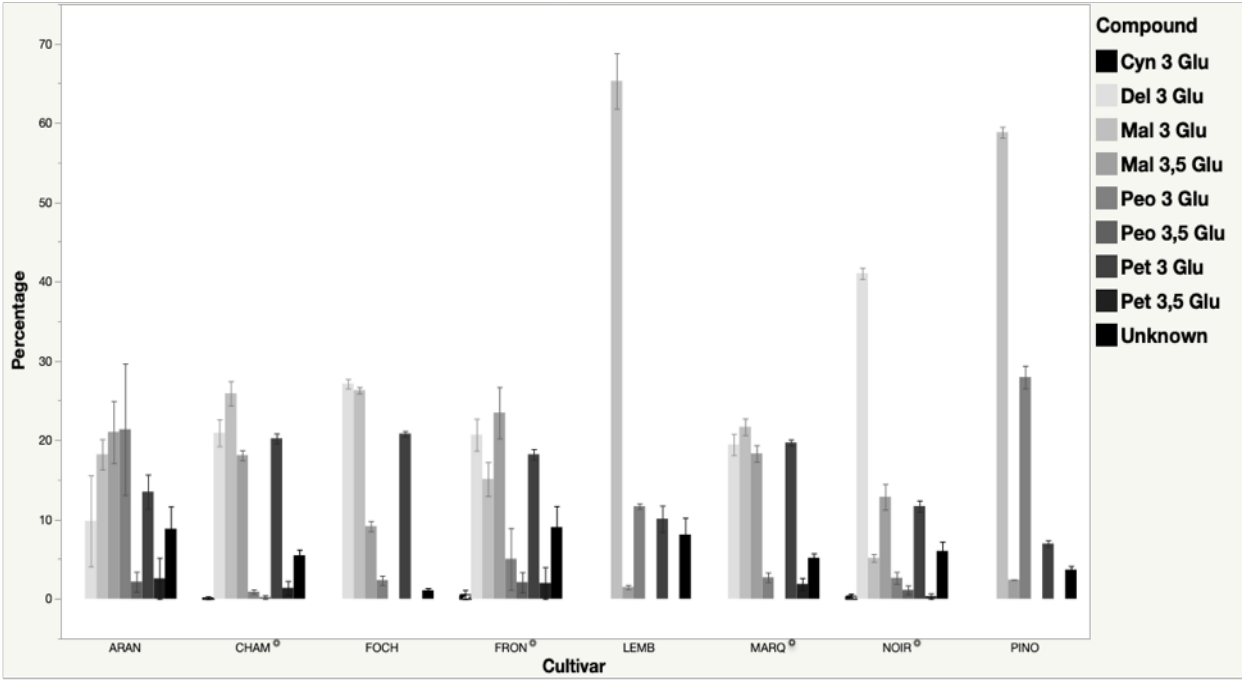
The *V. vinifera* cultivars, Pinot Noir and Lemberger, had the greatest amounts of malvidin-3-glucoside as expressed as percentage of total anthocyanins, though Maréchal Foch had a greater concentration. *V. vinifera* varieties also had the smallest amount of malvidin diglucoside by both

percentage of total and concentration. Noiret had the largest amount of delphinidin-3-glucoside by percentage of total anthocyanins and concentration.

Concentration vs. Percentage Make-up

Analysis of least square means and significance showed that differences in anthocyanin percentage of total were more significant than differences in concentration (Tables 4 and 5.) When diglucosides were found, their concentrations did not differ significantly among cultivars.

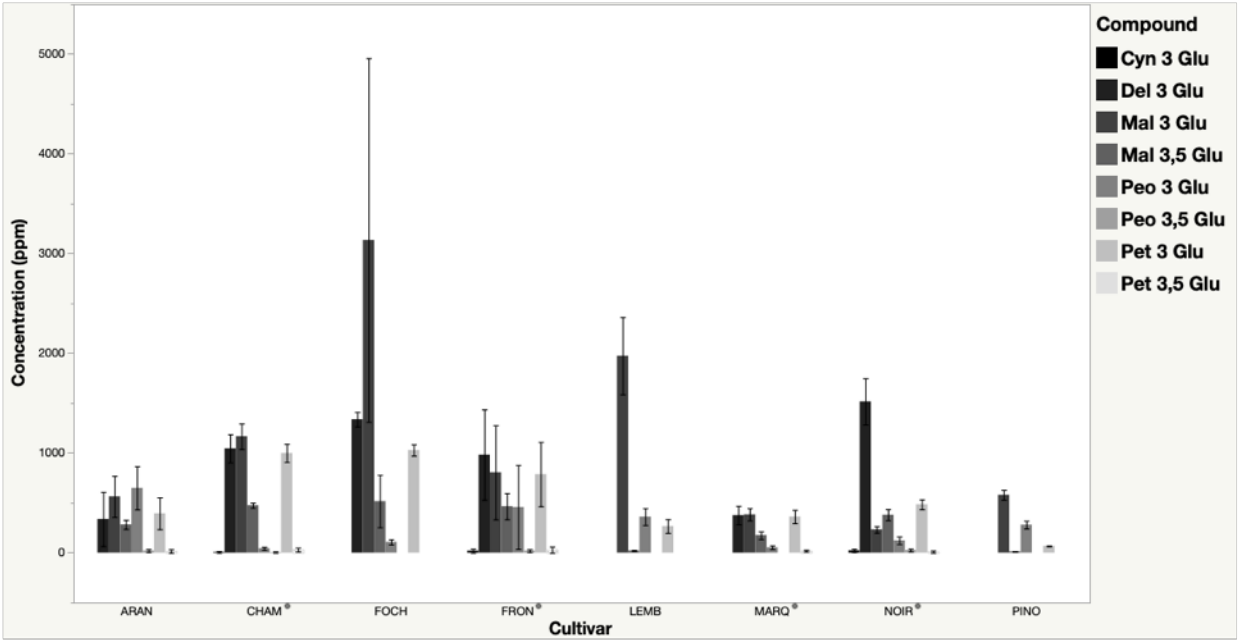
Figure 1. Anthocyanins Displayed by Percentage of Totals in Sampled New York State Grown Grapes



° Indicates cultivar where samples from both 2016 and 2017 vintage were analyzed

ARAN = Arandell
CHAM = Chambourcin
FOCH = Maréchal Foch
FRON = Frontenac
LEMB = Lemberger
MARQ = Marquette
NOIR = Noiret
PINO = Pinot Noir

Figure 2. Anthocyanins Displayed by Total Concentration in Sampled New York State Grown Grapes



° *Indicates cultivar where samples from both 2016 and 2017 vintage were analyzed*

ARAN = Arandell
CHAM = Chambourcin
FOCH = Maréchal Foch
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LEMB = Lemberger
MARQ = Marquette
NOIR = Noiret
PINO = Pinot Noir

Table 4. Significance of Anthocyanin Content Percent of Total in Grape Samples (p <.05)

Anthocyanin	Lemberger	Pinot Noir	Maréchal Foch	Chambourcin	Marquette	Frontenac	Noiret	Arandell
Malvidin-3-glucoside	A	A	B	BC	BC	A	D	BC
Malvidin-3,5-glucoside	A	A	A	A	A	A	A	A
Petunidin-3-glucoside	CD	D	A	A	A	AB	BCD	ABC
Peonidin-3-glucoside	ABC	A	CD	D	BCD	ABCD	CD	AB
Delphinidin-3-glucoside	-	-	B	B	B	B	A	B
Petunidin-3,5-glucoside	-	-	-	A	A	A	A	A
Peonidin-3,5-glucoside	-	-	-	B	-	A	AB	A
Cyanidin-3-glucoside	-	-	-	A	-	A	A	-

Table 5. Significance of Anthocyanin Content Concentration in Grape Samples (p <.05)

Anthocyanin	Lemberger	Pinot Noir	Maréchal Foch	Chambourcin	Marquette	Frontenac	Noiret	Arandell
Malvidin-3-glucoside	A	A	A	A	A	A	A	A
Malvidin-3,5-glucoside	A	A	A	A	A	A	A	A
Petunidin-3-glucoside	BC	C	A	A	BC	AB	BC	BC
Peonidin-3-glucoside	AB	AB	AB	B	B	AB	AB	A
Delphinidin-3-glucoside	-	-	A	AB	B	AB	A	B
Petunidin-3,5-glucoside	-	-	-	A	A	A	A	A
Peonidin-3,5-glucoside	-	-	-	A	-	A	A	A
Cyanidin-3-glucoside	-	-	-	A	-	A	A	-

Although malvidin is the largest contributor to the total make-up of anthocyanin profiles, there is no significant difference in the concentration of either malvidin-3-glucoside or malvidin-3,5-glucoside among any of the cultivars.

Discussion

Differences between Vitis vinifera and Interspecific Hybrids

The greatest differences in anthocyanin profiles were between *V. vinifera* and interspecific hybrid cultivars, as demonstrated by the ratio of mono- to diglucosides, which were generally much lower in hybrid cultivars (Table 6.) Given that diglucosides have slower reaction rates in color stabilizing reactions, yet remain vulnerable to bleaching, a greater concentration of diglucoside anthocyanins may indicate less stable color. Previous studies have focused on the development of wine color by tracking the color changes of single-species (mono- and di-glucosides treated separately) anthocyanins in mode wine solutions and comparing that to solutions with a single-species but containing both mono- and di-glucoside forms (Burtch et al, 2017). This allows initial association of specific anthocyanin profiles with expected wine color.

Hybrid grapes may produce wine in which color develops more slowly, as diglucoside anthocyanins are believed to compete with monoglucosides for other necessary reactants. The work by Burtch et al also indicates that in competitive solutions, those containing both mono- and diglucoside anthocyanins, delphinidin will develop into a more blueish tone. Sampled Noiret grapes had more delphinidin than any other sampled cultivar and may develop more blueish color. In competitive solutions cyanidin and malvidin did not develop new colors but remained red (Burtch et al 2017). Frontenac, Chambourcin, and Noiret are the only cultivars where cyanidin-3-glucoside was measured (no cyanidin-3,5-glucoside was found in any cultivar). Lemberger, Pinot Noir, and Frontenac have the largest proportion of malvidin-3-glucoside, and no significant difference among cultivars found for malvidin-3,5-glucoside. This suggests that these cultivars may exhibit a lesser degree of change than others. However, because investigations into anthocyanins and color development are still in early stages, dealing only with solutions of one or two anthocyanin species at a time, it is impossible to apply these results in an unqualified way to grapes that have a much greater variety of component anthocyanins.

Arandell had the lowest ratio of monoglucosides to diglucosides, at 2.17, indicating it may have less stable color over time; Chambourcin, at 2.64, and Marquette, at 2.82, are similar. On the other hand, Frontenac's ratio of 8.8 is almost like that of Pinot Noir (10.6), which may suggest stability. These results comport with established experimental and experiential outcomes (Zhu, et al. 2012).

Table 6. Total Mono- and Di-Glucoside Anthocyanin Content by Percent of Total and Ratios in Grape Samples

	Monoglucoside	Diglucoside	Ratio of Mono:Di
Lemberger	96.2	3.8	25.3
Pinot Noir	91.4	8.6	10.6
Maréchal Foch	82.7	17.3	4.78
Chambourcin	72.5	27.5	2.64
Marquette	73.8	26.2	2.82
Frontenac	89.8	10.2	8.8
Noiret	75.2	24.8	3.03
Arandell	68.5	31.5	2.17

A greater array of anthocyanin species, with the potential to affect final wine color, were found in hybrid grape cultivars. Only four anthocyanins were identified in the *V. vinifera* cultivars sampled, but 5-8 anthocyanins were identified in hybrid samples. This suggests that the more complicated parentage of hybrids, which by definition includes at least two, but often more, *Vitis* species, introduces a greater variation of anthocyanin production. Arandell is comparatively new cultivar with a documented pedigree including *V. cinerea*, *V. rupetris* (Reisch et al 2014), *V. aestivalis,* and *V. vinifera,* as found on the The Vitis International Variety Catalogue (http://www.vivc.de/index.php?r=passport%2Fview&id=11558). All hybrids analyzed have similarly complicated ancestries and include several *Vitis* species, creating cultivars that are today more various in their expression of anthocyanins than single-species cultivars like Lemberger.

Concentration vs. Percentage Make-up

The types and ratios of anthocyanins found in different cultivars are more notable than the concentration of specific anthocyanin species. Though concentrations of petunidin-3-glucoside, peonidin-3-glucoside, and delphinidin-3-glucoside differed by cultivar, the variation was not great.

For example, the concentration of delphinidin-3-glucoside distinguished Maréchal Foch and Noiret from Arandell or Marquette, though not from one another, but Chambourcin or Frontenac could not be distinguished from any other hybrid.

Noiret

Noiret is the most easily identifiable by anthocyanin concentration; it is notable for having the least malvin-3-glucoside and the most delphinidin-3-glucoside as a percentage of total anthocyanins. Such a pronounced difference may make Noiret will be easier to 'fingerprint' than other cultivars (Thimothe et al. 2007). The high percentage of delphinidin-3-glucoside in Noiret may be important to its visual appearance, because delphinidin-3-glucoside is perceived as having a cooler, more purple hue at wine pH (He et al. 2012). The unusually small amount of malvindin-3-glucoside contributes to Noiret's low mono- to diglucoside ratio.

Averaging over Vintages

To create a true average of these cultivar's anthocyanin profiles, samples from both 2016 (when available) and 2017 were averaged together. As the growing conditions in these years were very different, this created a set of values that reflected a more accurate profile of the anthocyanins produced by each cultivar studied in the Finger Lakes AVA. The 2016 season included a record-breaking drought and hot weather, while 2017 was cold and many wine-makers struggled to fully ripen their crop. Although these years were fairly extreme they do not account for all possibilities for vintage variations, especially as the effects of climate change begin to unfold in the Finger Lakes region. More vintages should be sampled to create a more complete and robust profile of cultivars that reflect a warming region.

Conclusion

This study represents an initial survey of the average anthocyanin profiles of six commercially important inter-specific grape cultivars and two *V. vinifera* cultivars. Findings

suggest that the ratios of anthocyanins, both as individual species and as summed mono- and di-glucosides, were most useful for distinguishing cultivars. This may indicate a common range anthocyanins are produced at when a cultivar expresses that species of anthocyanin. Rather than looking to absolute quantities or concentrations of an anthocyanin or sets of anthocyanins in order to identify a cultivar, it may be more useful to examine relative ratios of identifiable anthocyanins. Because the different anthocyanins have different color properties, their relative ratios also provide clues to the color of the grape and resulting juice and wine. Of the hybrids studied, Noiret showed the greatest variance from other cultivars due to low malvindin-3-glucoside and high delphinidin-3-glucoside. Refining these profiles, especially for understudied cultivars like Arandell, would be an especial boon to this area of study.

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APPENDIX A

Identification, Percentage of Total, and Quantification, of Individual Cultivar Samples

Sample	Variety	Compound	Percentage	Quantification (ppm)
17LEMB3	Lemberger	Mal 3,5 Glu	1.954	31.997
17LEMB3	Lemberger	Pet 3 Glu	12.935	385.651
17LEMB3	Lemberger	Peo 3 Glu	11.1275	473.1425
17LEMB3	Lemberger	Mal 3 Glu	59.497	2499.7925
17LEMB3	Lemberger	Unknown	11.72	N/A
17LEMB1	Lemberger	Mal 3,5 Glu	1.023	11.2985
17LEMB1	Lemberger	Pet 3 Glu	7.26	148.5715
17LEMB1	Lemberger	Peo 3 Glu	12.24	250.1095
17LEMB1	Lemberger	Mal 3 Glu	71.117	1451.576
17LEMB1	Lemberger	Unknown	4.485	N/A
17PINO1	Pinot Noir	Mal 3,5 Glu	2.454	15.2315
17PINO1	Pinot Noir	Pet 3 Glu	6.299	71.947
17PINO1	Pinot Noir	Peo 3 Glu	30.424	347.9695
17PINO1	Pinot Noir	Mal 3 Glu	57.718	659.8365
17PINO1	Pinot Noir	Unknown	2.94	N/A
17PINO3	Pinot Noir	Mal 3,5 Glu	2.3785	11.1205
17PINO3	Pinot Noir	Pet 3 Glu	7.665	65.1385
17PINO3	Pinot Noir	Peo 3 Glu	25.5005	214.372
17PINO3	Pinot Noir	Mal 3 Glu	59.9595	500.025
17PINO3	Pinot Noir	Unknown	4.42	N/A
17FOCH1	Maréchal Foch	Del 3 Glu	28.81	1376.395
17FOCH1	Maréchal Foch	Mal 3,5 Glu	7.5665	1019.0505
17FOCH1	Maréchal Foch	Pet 3 Glu	21.7905	1040.205
17FOCH1	Maréchal Foch	Peo 3 Glu	2.239	106.685
17FOCH1	Maréchal Foch	Mal 3 Glu	27.21	6797.8815
17FOCH1	Maréchal Foch	Unknown	0.5205	N/A
17FOCH2	Maréchal Foch	Del 3 Glu	25.6275	1449.578
17FOCH2	Maréchal Foch	Mal 3,5 Glu	8.8335	269.6135
17FOCH2	Maréchal Foch	Pet 3 Glu	20.18	1140.822
17FOCH2	Maréchal Foch	Peo 3 Glu	0.9605	48.511

17FOCH2	Maréchal Foch	Mal 3 Glu	26.6065	1501.409
17FOCH2	Maréchal Foch	Unknown	15.5985	N/A
17FOCH3	Maréchal Foch	Del 3 Glu	26.939	1188.119
17FOCH3	Maréchal Foch	Mal 3,5 Glu	11.079	263.994
17FOCH3	Maréchal Foch	Pet 3 Glu	20.5275	905.176
17FOCH3	Maréchal Foch	Peo 3 Glu	3.8095	168.009
17FOCH3	Maréchal Foch	Mal 3 Glu	25.105	1107.252
17FOCH3	Maréchal Foch	Unknown	1.2135	N/A
16MARQ1	Marquette	Pet 3,5 Glu	4.8695	59.155
16MARQ1	Marquette	Del 3 Glu	15.0995	339.518
16MARQ1	Marquette	Mal 3,5 Glu	22.9765	278.931
16MARQ1	Marquette	Pet 3 Glu	18.4725	415.191
16MARQ1	Marquette	Mal 3 Glu	0	512.855
16MARQ2	Marquette	Pet 3,5 Glu	2.6025	22.1715
16MARQ2	Marquette	Del 3 Glu	18.699	294.8685
16MARQ2	Marquette	Mal 3,5 Glu	16.8775	103.635
16MARQ2	Marquette	Pet 3 Glu	20.9995	330.1175
16MARQ2	Marquette	Peo 3 Glu	3.063	48.0435
16MARQ2	Marquette	Mal 3 Glu	23.6385	370.5645
17MARQ2	Marquette	Del 3 Glu	19.3495	103.887
17MARQ2	Marquette	Mal 3,5 Glu	17.516	50.421
17MARQ2	Marquette	Pet 3 Glu	20.237	108.224
17MARQ2	Marquette	Peo 3 Glu	3.8705	20.602
17MARQ2	Marquette	Mal 3 Glu	23.1585	123.165
17MARQ2	Marquette	Unknown	5.199	N/A
17MARQ3	Marquette	Del 3 Glu	24.7005	769.735
17MARQ3	Marquette	Mal 3,5 Glu	15.964	268.52
17MARQ3	Marquette	Pet 3 Glu	19.1315	595.8955
17MARQ3	Marquette	Peo 3 Glu	3.918	121.971
17MARQ3	Marquette	Mal 3 Glu	17.123	533.003
17MARQ3	Marquette	Unknown	5.132	N/A
16NOIR1	Noiret	Del 3 Glu	42.424	1480.125
16NOIR1	Noiret	Peo 3,5 Glu	1.33	20.827
16NOIR1	Noiret	Mal 3,5 Glu	11.0125	207.423
16NOIR1	Noiret	Pet 3 Glu	9.7855	341.164
16NOIR1	Noiret	Peo 3 Glu	1.523	53.155
16NOIR1	Noiret	Mal 3 Glu	3.35	116.875
16NOIR1	Noiret	Unknown	9.3325	N/A

17NOIR1	Noiret	Cyn 3 Glu	0.6835	41.159
17NOIR1	Noiret	Pet 3,5 Glu	1.3615	43.1995
17NOIR1	Noiret	Del 3 Glu	42.2475	1410.857
17NOIR1	Noiret	Peo 3,5 Glu	1.344	43.7165
17NOIR1	Noiret	Mal 3,5 Glu	13.633	438.034
17NOIR1	Noiret	Pet 3 Glu	11.504	684.107
17NOIR1	Noiret	Peo 3 Glu	4.0815	242.6655
17NOIR1	Noiret	Mal 3 Glu	5.8805	349.648
17NOIR2	Noiret	Del 3 Glu	37.9855	1511.8625
17NOIR2	Noiret	Peo 3,5 Glu	1.841	41.759
17NOIR2	Noiret	Mal 3,5 Glu	16.8425	521.8235
17NOIR2	Noiret	Pet 3 Glu	11.959	475.7825
17NOIR2	Noiret	Peo 3 Glu	5.002	198.8395
17NOIR2	Noiret	Mal 3 Glu	6.66	264.83
17NOIR2	Noiret	Unknown	4.906	N/A
17NOIR3	Noiret	Cyn 3 Glu	0.848	37.834
17NOIR3	Noiret	Del 3 Glu	41.5345	1665.8255
17NOIR3	Noiret	Mal 3,5 Glu	9.979	357.092
17NOIR3	Noiret	Pet 3 Glu	13.5495	438.154
17NOIR3	Noiret	Mal 3 Glu	4.7575	203.8395
17NOIR3	Noiret	Unknown	5.5165	N/A
16FRON2	Frontenac	Del 3 Glu	18.351	1220.141
16FRON2	Frontenac	Peo 3,5 Glu	2.562	15.869
16FRON2	Frontenac	Mal 3,5 Glu	22.1405	499.6435
16FRON2	Frontenac	Pet 3 Glu	17.2055	953.6685
16FRON2	Frontenac	Peo 3 Glu	8.316	860.329
16FRON2	Frontenac	Mal 3 Glu	16.401	1167.084
16FRON2	Frontenac	Unknown	7.768	N/A
17FRON1	Frontenac	Cyn 3 Glu	1.1205	40.14
17FRON1	Frontenac	Pet 3,5 Glu	3.9895	62.1055
17FRON1	Frontenac	Del 3 Glu	23.0345	745.7155
17FRON1	Frontenac	Peo 3,5 Glu	1.6475	25.65
17FRON1	Frontenac	Mal 3,5 Glu	24.8145	432.575
17FRON1	Frontenac	Pet 3 Glu	19.241	622.0635
17FRON1	Frontenac	Peo 3 Glu	1.741	56.1255
17FRON1	Frontenac	Mal 3 Glu	13.812	444.9885
17FRON1	Frontenac	Unknown	5.797	N/A
17ARAN1	Arandell	Pet 3,5 Glu	5.1675	33.698

17ARAN1	Arandell	Del 3 Glu	19.6625	675.6655
17ARAN1	Arandell	Peo 3,5 Glu	2.308	15.0495
17ARAN1	Arandell	Mal 3,5 Glu	23.5105	315.661
17ARAN1	Arandell	Pet 3 Glu	17.196	542.9235
17ARAN1	Arandell	Peo 3 Glu	8.2855	437.609
17ARAN1	Arandell	Mal 3 Glu	17.131	644.255
17ARAN1	Arandell	Unknown	1.9225	N/A
17ARAN2	Arandell	Peo 3,5 Glu	2.015	27.884
17ARAN2	Arandell	Mal 3,5 Glu	18.56	251.0525
17ARAN2	Arandell	Pet 3 Glu	9.835	246.183
17ARAN2	Arandell	Peo 3 Glu	34.4725	863.215
17ARAN2	Arandell	Mal 3 Glu	19.312	483.6075
17ARAN2	Arandell	Unknown	11.348	N/A
16CHAM1	Chambourcin	Del 3 Glu	18.833	903.4475
16CHAM1	Chambourcin	Mal 3,5 Glu	19.323	500.5885
16CHAM1	Chambourcin	Pet 3 Glu	20.152	966.9125
16CHAM1	Chambourcin	Peo 3 Glu	0.7485	40.577
16CHAM1	Chambourcin	Mal 3 Glu	26.152	1000.939
16CHAM1	Chambourcin	Unknown	4.9985	N/A
17CHAM1	Chambourcin	Pet 3,5 Glu	4.112	94.8075
17CHAM1	Chambourcin	Del 3 Glu	17.846	784.0615
17CHAM1	Chambourcin	Mal 3,5 Glu	18.109	418.43
17CHAM1	Chambourcin	Pet 3 Glu	18.8335	824.8565
17CHAM1	Chambourcin	Peo 3 Glu	1.2745	55.2435
17CHAM1	Chambourcin	Mal 3 Glu	29.953	1296.148
17CHAM2	Chambourcin	Cyn 3 Glu	0.435	24.287
17CHAM2	Chambourcin	Peo 3,5 Glu	0.6515	19.4935
17CHAM2	Chambourcin	Del 3 Glu	26.1075	1450.545
17CHAM2	Chambourcin	Mal 3,5 Glu	16.9135	507.805
17CHAM2	Chambourcin	Pet 3 Glu	21.733	1207.527
17CHAM2	Chambourcin	Peo 3 Glu	0.6645	36.8
17CHAM2	Chambourcin	Mal 3 Glu	21.6415	1202.483
17CHAM2	Chambourcin	Unknown	5.977	N/A

CONCLUSION

Beer Consumer Studies

These studies examined several ways that breweries interacted with their customers, how customers responded, and ways that customers indicated that they would appreciate being treated or marketed to. The analysis of paper surveys distributed across the state revealed that consumers reacted positively to two major factors: comfortable, attractive and clean interior brewery spaces and friendly, knowledgeable servers. Consumers didn't just rate breweries more highly when they experienced these factors in particular, but they were more likely to purchase beer, spend more money, buy more beer in total.

Research into the topic of consumer behavior and attitudes in New York State breweries will continue, as this industry is growing and serving the state-wide economy and its rural agricultural communities. Continuing research should widen the base of consumers reached with surveys and attempt to ascertain if the customer satisfaction profit chain changes with the seasons and how it affects other beer tourism activities like festivals or concerts. In future studies utilizing surveys, the method of distributing and collecting the surveys should be reconsidered. Instead of using identical, paper-copies of the survey future work could utilize a digital format so as to allow more privacy for survey participants which in turn may encourage more honest feedback. A digital presentation would also allow for rotation of attributes to prevent the order in which attributes are surveyed influencing the results, for example the last attribute being penalized because the customer is tired or bored by answering questions. Because survey participants often failed to report their spending future surveys could require the submission of their actual receipt or other proof of what they spent. Collected receipts could take the form of a physical receipt or a photo of their receipt.

Two focus groups were used to further investigate the characteristics that make beer and breweries appealing. Focus groups stratified by expertise in beer were used to investigate the appeal of different beer descriptions and how expertise effected descriptive language use. Experience effected what information consumers responded to most positively, but it was found that generally consumers appreciated being given lots of information including intended style, ABV, IBU, and level of sweetness. Novice drinkers responded well to trusted brands, those with intermediate expertise to ingredient labeling and explanations of the brewing process, and experts liked clear tasting notes and food pairings. Further study in this vein should attempt to include a wider variety of beer styles to create a more complete picture of consumer's language use in the entire category of craft beer.

A focus group composed of only of women also described what made a brewery or other drinking space more comfortable for female customers, although it did not directly measure whether increased comfort lead to more spending. Even in a single-gender space, this study elicited much the same information as the much more general study in the areas that were investigated in both studies. Women were interested in breweries that provided comfortable and clean spaces, offered welcoming service that neither treated them condescendingly because of their gender nor attempted to go over-the-top with "ladies-night" type gimmicks, and served good quality beer. Women expressed the desire to be treated much the same as they saw their male companions being treated – as patrons who could appreciate and value the products being offered by breweries. To fully distinguish between opinions that are held primarily by women and those held by the general population a similar focus group would need to be held with either a mixed-gender or male-only focus goup.

When women were asked about the appeal of various beer labels, ranking and offering qualitative comments, it was found that imagery that evoked nature and language that recalled the

concept of "local" was most appealing, while imagery and language that was overtly sexual was very unappealing. Labels that were eye-catching, with bright colors and funny text, and those that provided lots of information about the beer also received high marks. Research into women as consumers of beer and customers of breweries should continue to reduce gender bias in the industry and to improve sales, leveraging a previously underutilized market segment. To continue this investigation, future women-only focus groups should be presented with researcher-created faux beer labels or components of beer labels. By proceeding in this manner researchers can be sure to cover a wide range of common beer marketing elements without contamination by participant's previous experience with and opinions of particular, existing brands. A female-only focus group could be led that mimicked the expertise and language focus group to increase knowledge about gendered use of descriptive language associated with beer, an important part of marketing. This could also be particularly illuminating about women's ideas and experience about the concept of expertise in beer, which as a product and an interest has been traditionally identified as male.

Anthocyanin Profiles

Samples from six different interspecific hybrid grape cultivars and two *Vitis vinifera* cultivars were characterized for average anthocyanin profiles via HPLC. Hybrid cultivars had greater ratios of diglucoside to monoglucoside anthocyanins, an important characteristic that affects the commercial acceptability of a wine's color as it ages. Hybrids were also found to express a wider variety of anthocyanin species than vinifera cultivars. Important differences in specific anthocyanin species were found, especially those which made the Noiret cultivar distinct.

Continuing this research by connecting the research done by Burtch et al and the development of color in different anthocyanins in model wine solutions and the anthocyanin profiles of economically important hybrid grape cultivars, will provide important insight into how

anthocyanins influence color development in wines made from hybrid grapes. This will require creating model wine solutions with anthocyanin components that mimic the profiles of actual cultivars and following the changes in anthocyanin profiles and color. Additionally, expanding the sample database will be particularly important. More samples may increase the significance of results that which cannot yet be conclusively defined. Collecting samples from more vintages will also help answer the question, “Does vintage affect anthocyanin development at the cultivar level?”